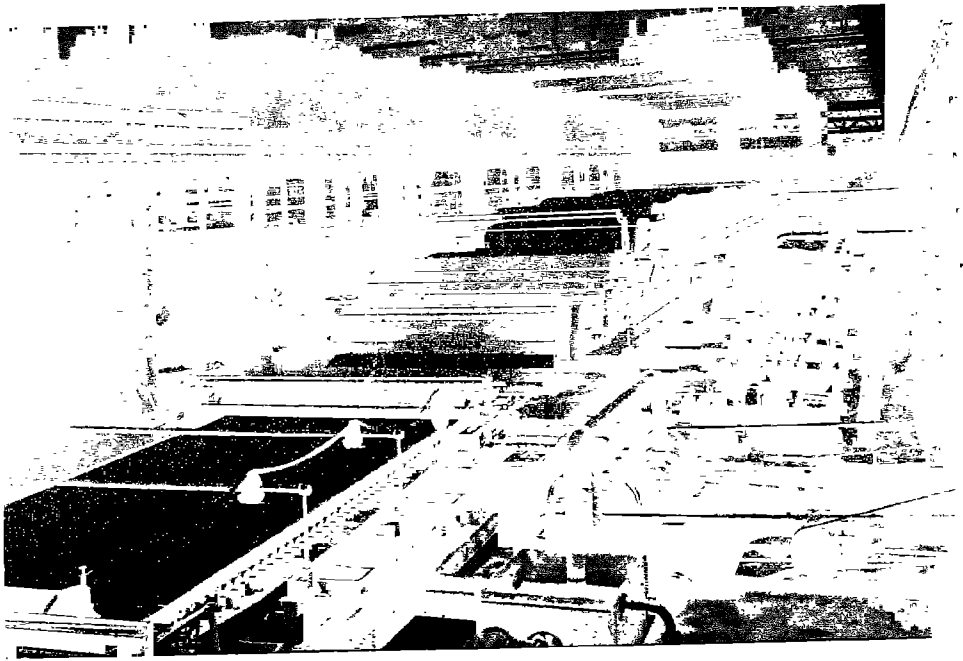
PAPER AND ITS USES



Frontispiece.

VIEW OF PAPER MACHINE.

PAPER AND ITS USES

A TREATISE FOR PRINTERS STATIONERS AND OTHERS

BY

EDWARD A. DAWE

FOURTH EDITION REVISED

VOLUME ONE

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PREFACE

THE manufacture of paper is a progressive industry, and there are many books which deal with the subject from the standpoint of the papermaker, treating in detail the varied subjects of fuel, water, steam raising, motive power, and engineering. The aim of this work is to present the essential details of paper manufacture to the user—printer, stationer, bookbinder—in order that the problems which arise in dealing with the finished papers may be approached intelligently. The difficulties of the users, together with appropriate remedies, are set out in detail, and it is hoped that the section will prove of assistance to the papermaker and distributor, and lead to a sympathetic understanding of the troubles of the consumer.

The book is divided into four sections — Paper Manufacture, Papers and Cards of Various Kinds, the Use of Paper, and Samples of Papers and Cards. The practical side of paper handling is specially kept in mind, for most students have great difficulty in collecting reliable information regarding qualities and prices of various supplies, and do not readily acquire the necessary experience in "handling" paper, by which must be understood not only the rapid estimation of the substance of the sample, but also correct classification and valuation. The collection of 150 samples of papers and boards is so bulky as to necessitate binding in a separate volume, where the arrangement is made so as to provide a comparative

collection affording the opportunity to inspect and judge the samples, with all the details to hand for purposes of checking. The compilation of the samples has been made in consultation with directors of various firms of wholesale stationers and technical instructors. Prices are those ruling at the time of writing, and it is unlikely that there will be any early alteration.

The adoption of the 1,000-sheet count and substance in terms of grammes per square metre are admittedly advances, but the Author, who has laboured since 1917 towards standardisation, trusts that his readers will give their support to the effort to deal with these matters in a scientific manner.

The Syllabus of the City and Guilds of London Institute for Typographic and Lithographic Students calls for a more detailed knowledge of the manufacture and use of paper than can be found in the text-books on printing. It will be found that all the demands of the Syllabus are met in this work, and the student is encouraged to travel beyond those requirements.

For the illustrations of methods of manufacture and various machinery and apparatus I am indebted to the manufacturers, and the samples have been furnished by the wholesale houses as assistance to the cause of technical education. My grateful thanks are tendered to these and other friends who have advised and guided these volumes to their final state.

EDWARD A. DAWE.

15 MALDON ROAD,
WALLINGTON, SURREY.

PREFACE TO FOURTH EDITION

THE fundamental processes which are comprised in papermaking have not altered since this work was first published. Skilful engineering and improved craftsmanship have made it possible to accelerate the production of many papers and to improve the quality of papers and boards in general use.

Additions and alterations in this edition include references to the ancillary matters of the centrifugal treatment of stuff; to the manufacture of two-ply paper and board; to the modern methods of coating papers intended for illustrated work; to standards for papers suggested by the Library Association; and to standardisation of paper under the auspices of the British Standards Institution.

Additional illustrations have been inserted, and I should like to record my indebtedness to the firms contributing to the usefulness of the book by the loan of blocks and photographs, and to friends who have made helpful suggestions now embodied in these pages.

E. A. D.

1939.

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SECTION I

MANUFACTURE OF PAPER

RAW MATERIALS

PAPER is one of the necessities of civilisation, and it is almost impossible to imagine the continuance of a world without the printed book and newspaper, devoid of the material necessary to convey the written word between correspondents, and to serve as the basis of commercial transactions of all kinds. In fact, it is an excellent mental exercise to traverse a week in one's life and to note the numerous occasions on which paper in one form or another affords service of more or less importance.

The word paper takes us back to papyrus, the Egyptian writing material made from the plant of that name. The papyrus is a kind of sedge, 8 ft. to 10 ft. high, with a strong woody root, long sharp-keeled leaves, and naked, leafless, triangular, soft, and cellular stems; the stems cut into thin longitudinal layers, arranged side by side, and fastened by transverse layers into sheets, the surface burnished, produced excellent paper. Originally white or cream in colour,

most of the known papyri are brown and are also very brittle.

Modern paper is made from cellulose derived from a limited number of plants, the fibres being mixed with sufficient water to render possible the formation of a continuous sheet or web of paper of uniform thickness. The invention of this method of papermaking is attributed to the Chinese, about 80 to 150 B.C.

European papermaking dates from the eleventh century, and English papermaking from the fifteenth century. The colophon to Wynkyn de Worde's "De Proprietatibus Rerum" mentions the paper mill of John Tate at Stevenage in Hertfordshire. Early English papers were made from rag fibres, and rag papers still hold the premier place.

Cellulose is the substance of which the permanent cell membranes of plants are composed, and it forms the bulk of the tissues of wood and similar plant structures. In most cases the presence of colouring matter and various waxy and resinous substances taken up by the growing plant render the cellulose impure, and it is desirable that, as far as possible, all impurities should be removed before the fibres are made into paper. Cotton is the purest form of cellulose found in Nature, 91 per cent. of the natural cotton fibre being pure cellulose, while esparto yields only about 50 per cent. of its weight as cellulose. Notwithstanding the many different varieties of plants, the chemical composition of the fibres is practically identical. One of the principal characteristics of cellulose is its extreme permanence, which is principally due to the fact that it forms but few chemical combinations with other substances.

Vegetable fibres of all kinds may be converted into paper, but no new fibre can displace those now employed, unless it can be obtained in large quantities, responds readily to the usual bleaching reagents, and can be delivered to the papermaker at a price which enables it to compete successfully with the fibres at present in use at the paper mill. In some cases the plant fibres are reduced to pulp near the place of growth, in others the raw material is transported in its entirety. Additional sources of supply are the wastes of other industries, and used materials which have no other market.

The classification of the raw materials in general use may take place as follows: (*a*) *waste*—rags, sails, sacking, ropes, textile wastes, waste paper; (*b*) *plant stems*—straw, esparto, bamboo; (*c*) *pulps or half-stuffs*—straw, esparto, bamboo, chemical wood, mechanical wood. There are many other possible sources of cellulose for papermaking, but it is unlikely that any great changes in the supplies of raw material will take place until there is scarcity of the foregoing materials, or until the prices become prohibitive owing to demands for the fibres from other industries, *e.g.*, for artificial silk manufacture.

Rags are the cast-off fabrics of the civilised world. Having served their purpose in administering to the comfort of mankind, they are sorted, graded, and offered in the market for papermakers. Sailcloth, bagging, sacking, and ropes, made from hemp, jute, manilla hemp, having reached the waste market, are regenerated in the mill as paper. Waste paper of all kinds is sorted and re-made into paper or boards.

Esparto is the principal material that finds its way

to the papermaker in its original state. It is a wiry grass, growing extensively in Spain and Africa, and is harvested and packed in bales for export. Straw is generally imported as half-stuff. Bamboo is used in a small way, but will doubtless be extensively used in the future.

Straw, esparto, and bamboo are obtainable as half-stuff or pulp, that is, they are already divested of the portions of the plant which are non-fibrous and therefore useless to the papermaker. Wood pulp is the chief material converted into paper, and may be prepared chemically or mechanically. Chemical wood pulp is prepared, after removing the bark from the felled trees, and cutting the logs into chips, by boiling with caustic soda solution (soda pulp), with a mixture of caustic soda and sulphate of soda (sulphate pulp), or with bi-sulphite of lime (sulphite pulp). Mechanical wood pulp is obtained by cutting the logs into short lengths, removing the bark, and grinding to pulp on a large grindstone, the surface of which is freely supplied with water. The water renders the reduction to pulp an easier matter, and also serves to carry the pulp forward for subsequent treatment.

In speaking of paper it is usual to refer to the material from which it is made, *e.g.*, rag, rope, esparto, manilla, or wood papers. It does not always follow that the papers are composed entirely of those fibres, but the prefix of "pure" or "all" will generally indicate the genuine articles. Paper which is free from mechanical wood pulp is sometimes referred to as "wood-free."

The strongest and best papers are made from cotton or linen rag fibres. Linen is made from the

fibres of the flax. In the raw state the fibres are from 30 mm. to 40 mm. in length, and .025 mm. in diameter. Examined microscopically the fibres appear to be smooth, cylindrical, with markings like the joints of a cane, slight cross markings, and a very fine channel running through the fibres. Papers made from linen are close, strong, and durable. Cotton is the seed-hair of the cotton plant, having a length of 30 mm. to 40 mm., with the diameter about the same as that of linen fibres. The fibre is tubular, has a large channel, and on drying the tube collapses and twists upon itself, as many as 300 twists in the length of a single fibre having been observed. This twisting assists in keeping the spun cotton together, and also makes the felting of the subsequent paper more efficient. Papers made from cotton are softer than those made from linen, and the tenderest rags, such as worn muslins, are employed for blotting papers. Hemp is obtained from the stem of the hemp plant, and the papermaker receives it in the form of old ropes and string. The dimensions and properties of the fibre are similar to those of the fibre of linen. Jute is the inner bark of an Indian plant, producing fibres 2.5 mm. in length by .022 mm. in diameter. The fibre is smooth, difficult to bleach, but the resulting paper is strong and tough. The fibre of the manilla hemp is not as long as the ordinary hemp, being about 7 mm. × .02 mm., cannot be bleached to a good white, so a white "manilla" paper is considerably lower in colour than other white papers. Manilla paper is, however, very tough and strong, and though a large quantity of "manilla" paper is made entirely of wood pulp, there is a great difference between the real and the imitation.

The fibres from straw are small, only about 1.5 mm. × .015 mm., and consequently straw papers are much weaker than those made from longer and broader fibres, but, as an admixture, straw still finds a place in some writing papers, giving translucency and rattle. Esparto fibres are also very short and fine, about 1.5 mm. × .012 mm., making a light bulky paper when used alone, and, blended with other materials —with rags for good writings, and with chemical wood for fine printings and litho. papers—to impart special characteristics, such as opacity and softness, which may be lacking in the other fibres. The well-known feather-weight papers, used for bulky volumes of fiction, are frequently manufactured from esparto fibre alone.

The fibres of the various wood pulps vary considerably in length, breadth, and thickness, being from 1 mm. to 3 mm. long, and generally very thin. Fibres of various shapes are met with in wood pulps, some not unlike linen fibres, but many others so distinct as to be unlike all those that have been already described. Broad, ribbon-like fibres, some pitted and others perforated, all are very thin, lying closely together, so that a paper made entirely from sulphite wood pulp is rather harsh and fairly transparent. Papers produced from soda pulp are softer and more opaque than those made from sulphite pulp. Strong papers are produced from chemical wood pulps, sulphite pulps being used for wrappings, printing and writing papers. Sulphate pulps in the natural shades are made into kraft wrapping papers, and when bleached find wide employment in white papers of various kinds. Mechanical wood pulp is made up of little pieces of wood with all the resins and other impurities of the

original wood, and when examined carefully the fragments of wood can be seen, and the splinters appear to be held together by the plant cells. Mechanical wood pulp possesses very little felting quality, and requires addition of longer fibres, such as chemical wood, in order to produce strength in the paper.

From the foregoing list and descriptions it can be seen that papermakers have a variety of fibres at their command, and it is by selecting, sometimes by blending, fibres of different characteristics, that the manufacture of the large variety of papers is possible. Some of the demands made by the world of paper users are for papers which are very strong or very soft, absorbent, resistant to grease or water, very light, very dense, and the selection of the fibres and their treatment call for special knowledge and skill on the part of the papermaker.

In addition to fibre, most papers contain sizing, sometimes loading or filling. Sizing may be animal or vegetable, the animal size being gelatine or glue obtained from various animal substances, and the vegetable size being made of a combination of rosin with soda. Alum is used to assist in fixing the size in the paper. Mineral matters are employed for filling or loading; china clay is the principal, others being barium sulphate (barytes, blanc fixe), calcium sulphate (gypsum, terra alba, annaline, pearl hardening, crown filler, satin white), magnesium silicate (asbestine, talc, agalite), and titanium oxide. Colouring matters are required for the majority of papers. For white papers small amounts of blue and red colours are used, while for coloured papers aniline dyes are employed in a large variety, as well as the various pigments.

REDUCTION TO PULP

Whatever material may be used for making into paper it has to pass through the following stages of preparation: removal of all foreign matter and dirt; reduction to fibrous state; bleaching; beating to a pulp with water; and lastly, converting the pulp into paper. If the material has already been manufactured, as in the case of rags, ropes, sails, sacking, and other textiles, the first process is somewhat simpler than in the case of untreated vegetable fibres, such as esparto, bamboo, or wood. But here again the first and second operations may have been carried out before the papermaker handles the material, for wood, esparto, and bamboo pulps are imported in sheets or boards. In the case of esparto the quantity so imported is very small, but the quantity of wood pulp is enormous.* It will be advisable to take the materials in order, so that the difference as well as the similarity of treatment may be traced.

Rags are purchased already graded. There are some twenty to thirty grades of rags regularly quoted in the market reports, and the layman might fancy that the papermaker could unpack the bales and proceed to make paper from these graded rags. Unfortunately he finds a large quantity of undesirable material, such as silk, wool, artificial silk, buttons, elastic, and dirt that must be removed. First the rags are sorted and cut into

* 1928—Chemical wood pulp, 479,270 tons; value, £5,769,987: mechanical wood pulp, 804,185 tons; value, £2,701,564.
1938—Chemical wood pulp, 953,758 tons; value, £10,104,971: mechanical wood pulp, 664,344 tons; value, £4,135,391. (1938 figures are for air-dry pulps.)

pieces of uniform size, the undesirable substances mentioned being put aside as useless, and the seams cut open or thrown out. Standing at a bench, the top of which is formed from wire netting, the sorter takes rags from a pile and cuts them on a scythe-like knife which stands out obliquely from the bench. A large amount of dust escapes through the netting, and the rags are sorted into various bins as more suitable for one class of paper than another. The rags are sometimes cut up by a mechanical rag cutter, this being a quicker process, but resulting in greater loss of fibre than is usual when rags are cut by hand. The rags are next taken to the willow or dusting machine, where they are subjected to violent treatment, the teeth of the machine carrying the rags against other teeth, giving them a thorough shaking and loosening the dust, which falls away. As they are cleaned, the rags are taken to the top of the building by a travelling band and dropped into the mouth of a boiler prepared to receive them. For rags a special spherical rotary boiler is employed, and when a charge has been filled in, a definite quantity of a solution of caustic soda in water is added. The lid is securely fastened, steam is passed in, and the boiler is kept rotating slowly for about eight hours. When the dirt in the rags has been thoroughly loosened the rotation is stopped, steam is shut off, the dirty water is run off, clean water is run in. The boiler is again revolved, the rags rinsed, and then the lid is removed and the boiler emptied by continuing the revolution, the contents falling to the concrete floor, which is provided with means for draining the rags.

Next comes the washing and breaking, both of

which may be carried out in the beating engine. The beating engine, of the Hollander type, consists of a large vessel with rounded ends, having a narrow partition, which is called the mid-feather, to divide it in the middle, but stopping short some distance from each end. Two cylinders revolve, one a very heavy cylinder known as the beating roll reaches to the bottom of the engine and bears a number of bars on its surface, which bars, in conjunction with a bedplate also bearing bars, breaks the rags into smaller fragments and opens the threads, loosening the fibres, and allowing dirt to come away. The second and smaller cylinder is employed as a washing drum. It is covered with wire gauze, through which the water passes, and as the drum revolves the dirty water passes into the interior, where a number of bucket compartments carry the water and pass it through the axis of the drum to the waste pipe. When the rags are filled into the beating engine clean water is run in, the beating roll is raised from the bedplate, and the rags are kept in circulation. The washing cylinder is in action, and the roll being gradually lowered, the dirt is eliminated. When this stage is reached the washing drum is lifted, the beating roll lowered, and the rags are gradually reduced in size until they attain a state of fibrous pulp, being known technically as "half-stuff." In most instances the next process is bleaching. There are special drawing papers, *e.g.*, "Unbleached Arnold," which are the colour of the original rags, no bleaching having taken place. But usually a weak solution of bleaching powder (chlorinated lime) is let into the engine and thoroughly mixed with the pulp. When the bleach is thoroughly

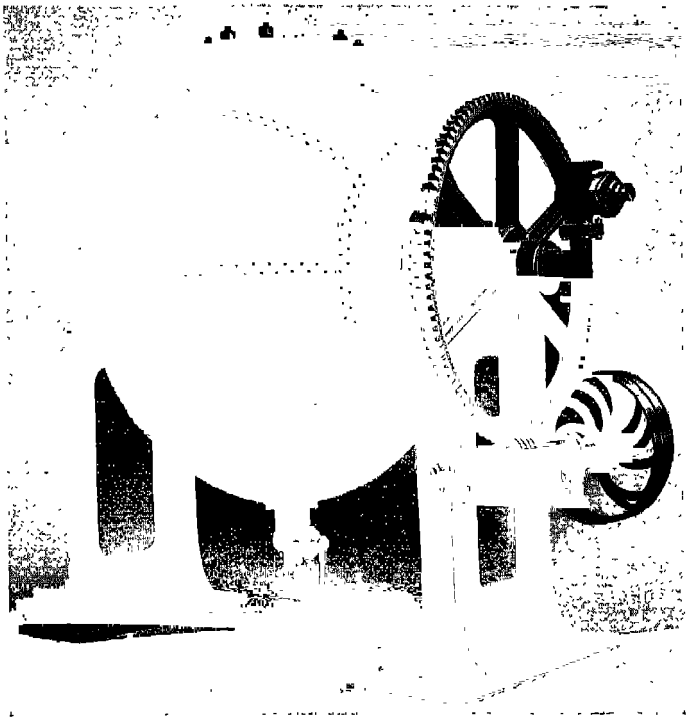

FIG. 1.—SPHERICAL RAG BOILER (*Bertrams Ltd.*).

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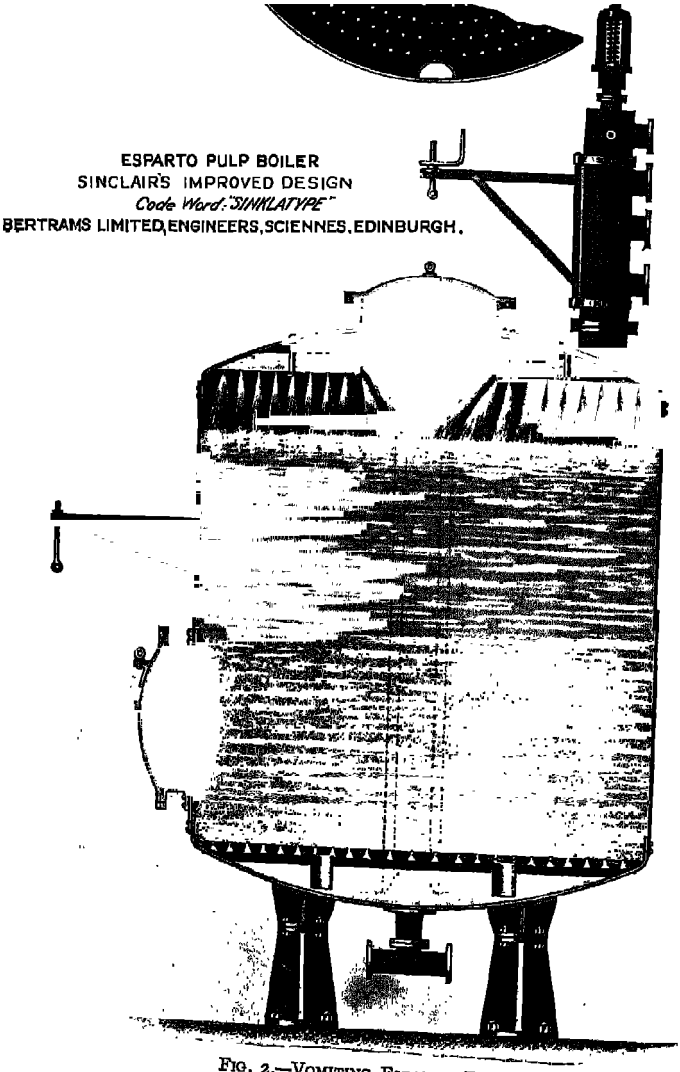

FIG. 2.—VOMITING ESPARTO BOILER.

[*To face p.* 1]

incorporated the half-stuff is let down into large tanks, made of stoneware or cement, having perforated bottoms, and there the bleach completes its task, and the pulp is allowed to drain. Bleach residues are washed away in the preliminary part of the next process.

Next comes the beating, at which stage the blending of different fibres may take place. The object of beating is to separate the bleached pulp to individual fibres, and to reduce the length of the fibre in accordance with the requirements of the paper to be made. The rags are chosen according to the class of paper desired —softer rags for soft papers, and, of course, stronger rags for strong papers, and the ratio of water to fibre is varied. For blottings, filter papers, and lithographic papers, soft rags, sharp beater knives, quick beating are adopted. For dense, hard papers, such as ledger, typewriting, bank, " extra strong " papers, less water, duller knives, slow beating, with a gradual lowering of the beater roll is the order. The normal time for an ordinary rag paper may be taken as eight hours.

To take the next material, esparto, and to follow it in the same way. Esparto arrives in bales, fastened either with ropes of esparto or with iron bands. Esparto travels through the mill in the same way as rags: it is unpacked on the ground floor, passed through a special machine to open and dust the " grass," and carried upwards by means of a series of claws, along a travelling band where pickers remove foreign substances. In its travel broken fibres and dirt escape, and the grass arrives at the mouth of an upright cylindrical stationary boiler. The boiler is filled, and a fairly strong solution of caustic soda is run in, the manhole is fastened down, and steam under pressure introduced.

The boiling liquor is vomited over the mass of esparto, and after several hours' boiling the silicious and waxy substances taken up by the growing plant are dissolved, the dirty water is run out, small quantities of clean water let in to wash out as much soda as possible. Most of the soda is recovered, but that process, though of great importance to the papermaker, need not be treated here. The boiled esparto is conveyed to the breaking engine for treatment similar to that given to rags, being washed, broken, and bleached. In many mills the half-stuff is carried over sand-tables and through revolving strainers, and by the use of the presse-pâte machine (a papermaking machine with only a " wet end ") made into sheets. The half-stuff in sheets is filled into trucks and stored or taken direct to the beaters. Owing to the small dimensions of esparto the reduction to the fibrous state is easily accomplished, and very little beating is necessary.

Wood, chemical or mechanical, usually finds its way to the paper mills in the form of pulp boards, and is known as chemical or mechanical wood pulp. No boiling is necessary, but the boards are fed into the breaking engine and reduced to half-stuff, a little bleach liquor added to chemical wood, and the contents of the engine, when sufficiently reduced, are let down to the draining tanks for the bleach to expend itself. Alternatively the half-stuff may be conveyed to bleaching towers, where in a series of vertical cylindrical chambers the process of bleaching is carried out. Then the pulp is ready for the beating engine, where it is reduced to the necessary degree of fineness.

Slush pulp is a term applied to wood pulp which has not been made into sheets, but travels right through

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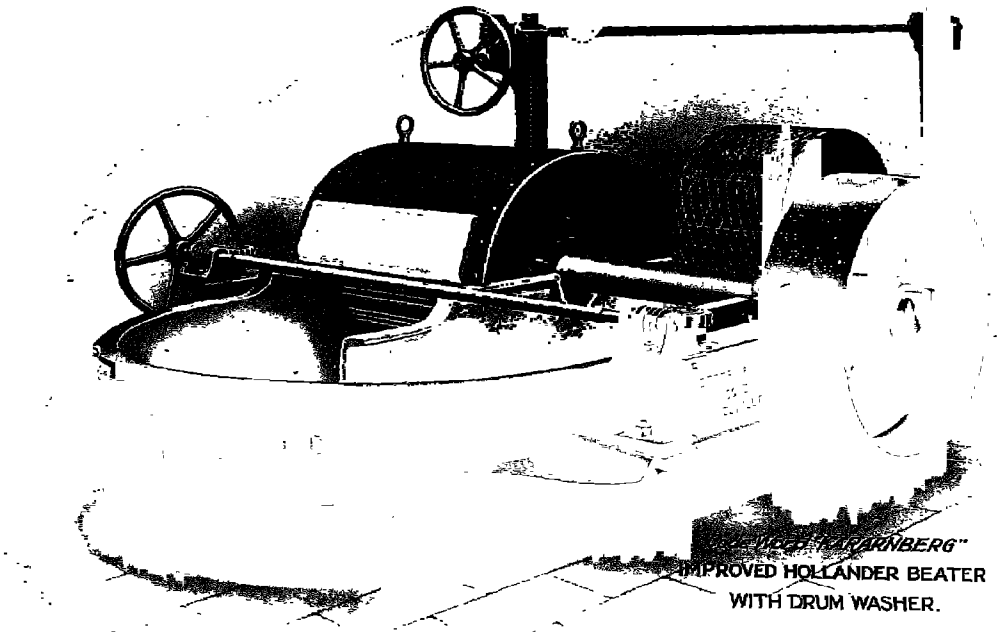

FIG. 3.—BEATING ENGINE.

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[To face p. 13.

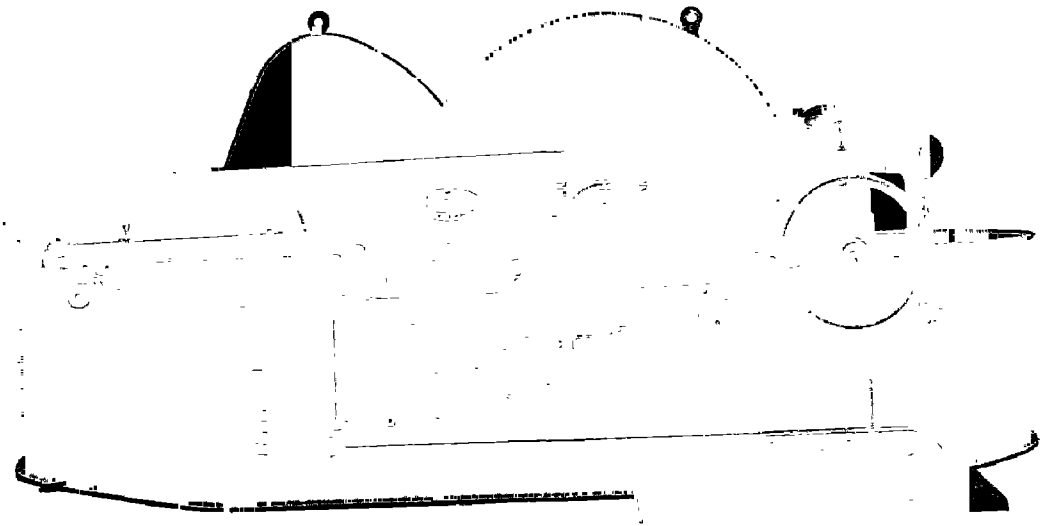

FIG. 4.—SCIENNES PATENT BEATER.

from the raw state as wood to the stuff chest without intermediate removal of water. Such pulp is sometimes pumped a considerable distance through a pipe line from the pulp mill to the paper mill.

Some materials are more effectively reduced to pulp in the edge-runner or kollergang. This machine is similar in appearance to a mortar mill, but the arrangement is slightly different. The pan of the machine is stationary, and the stones revolve and travel round the pan. Only a small quantity of water is used with the pulp, and waste papers which require rubbing apart only, and strong wood pulps of which the fibres are drawn out, and not in any way reduced in length, are treated in this machine economically and effectively.

PAPERMAKING BY HAND

English hand-made paper is still looked upon as the best paper obtainable. The number of mills devoted to the manufacture of hand-made papers appears to be diminishing gradually, although in some markets the demand for such papers is well maintained. After reduction of the rags to fibre and before leaving the beating engine, the colouring matter is added; in the case of a white paper a small amount of blue is necessary to counteract the grey appearance which the natural pulp usually assumes. This is merely equivalent to the blueing which is resorted to for giving linen a bright appearance, and is not sufficient to tint the paper. If the paper is to be blue laid, azure, or yellow wove, smalts is the colouring matter used. This is an

indestructible blue, being cobalt glass reduced to extremely fine powder, and is used for the highest grades of papers, but many hand-made papers will be found to be coloured with ultramarine, which is a very good blue, but not quite so durable as smalts. Coloured papers require different additions, some in the form of powders or dry colours, others in chemical solutions, which by combination produce the desired colour in the pulp. When thoroughly mixed, the pulp is let down to the stuff-chests and kept in constant motion by revolving paddles. The vat at which the paper-maker—the vatman—stands is kept supplied with pulp, diluted to a regular consistency, kept in motion by an agitator, and a constant temperature is maintained. The mould used is a wooden frame, strengthened by ribs across its width, and a wire top of laid or woven wire. In the case of laid papers the wires are laid side by side, tying wires about an inch apart are superimposed, and fastened to the laid wires by very fine brass wire. These wires make an indelible impression upon all paper made upon the mould, and distinguish laid from wove papers, the latter being made upon a woven wire mould. Watermarks are the results of designs in reverse fastened to the mould, the design being formed with wire upon the mould, or else an electrotyped mark is soldered to the mould. Watermarks may be simply small designs or lettering, or they may take the form of elaborate pictorial designs, but their purpose is to add distinction to the paper, and in some cases to prevent forgery of valuable notes or documents. Upon the mould is laid an open frame, known as the deckle, which serves to confine the pulp to the mould. For all papers two moulds are

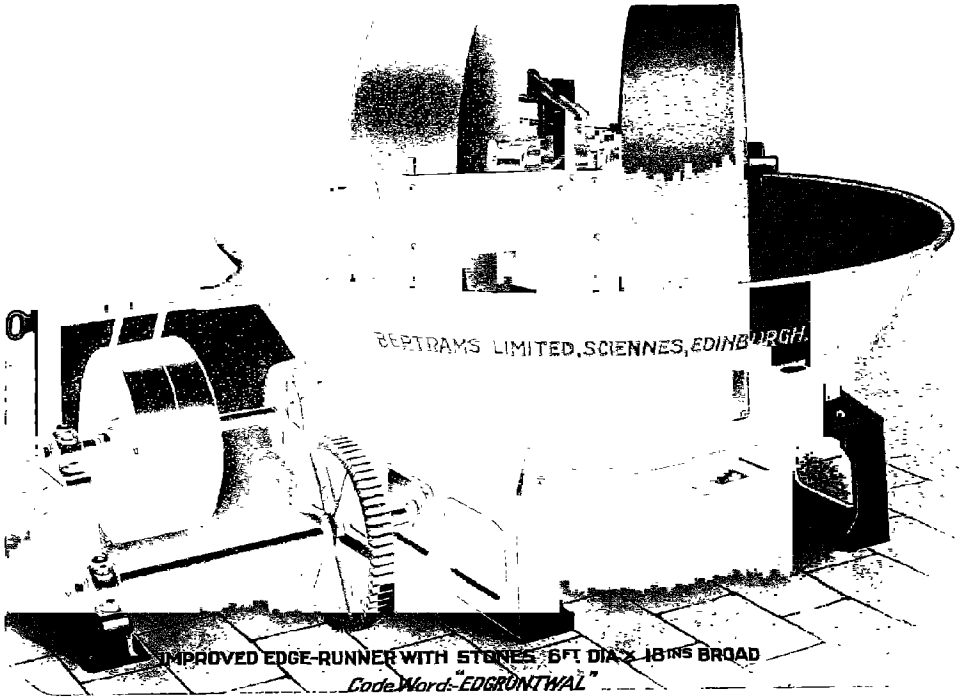

FIG. 5.—EDGE-RUNNER OR KOLLERGANG.

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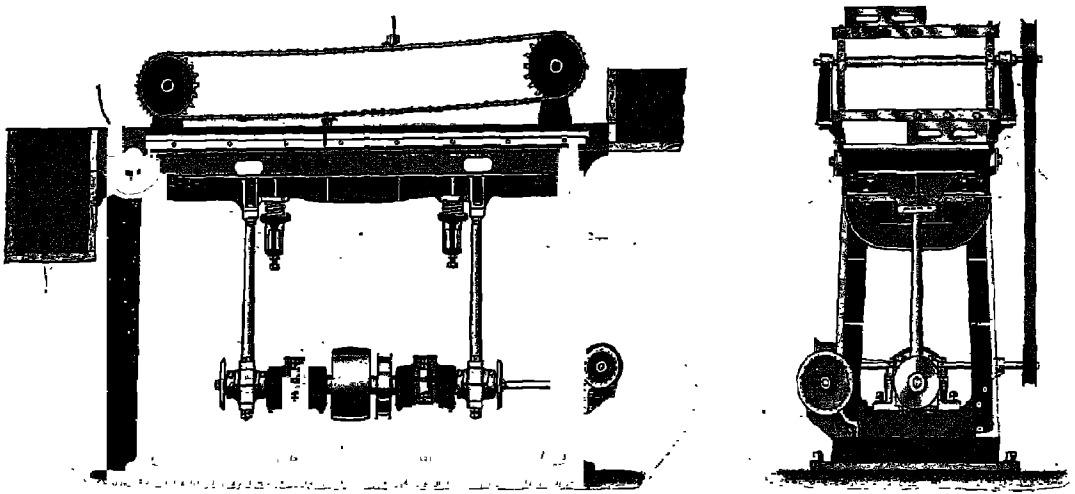


FLAT DIAPHRAGM STRAINER WITH SCRAPERS.

Code Word :– *"FLATSTRAIN"*

BERTRAMS LIMITED, ENGINEERS, SCIENNES, EDINBURGH.

FIG. 6.—FLAT STRAINER.

[*To face p.* 15.

used in order to continue the cycle of operations uninterruptedly.

The vatman takes a mould, places the deckle upon it, and dips the mould into the vat of diluted pulp. When clear of the pulp, a slight shake is given to the mould, a small side shake and a greater shake backwards and forwards (something like the shake given to a type case, but less violent), the object being to cause the individual fibres to cross and felt together; unless the mould is kept perfectly level, sheets of irregular thickness will result. The mould is pushed along a support by the side of the vat, the deckle removed, and the operations of moulding repeated with the second mould. The coucher, who places the paper upon the felts ready for pressing or couching, stands to the left of and facing the vatman. He takes the mould, stands it at an angle to drain, and places the mould face downwards upon a felt; the paper remains on the felt, and the mould is returned to the vatman. The felts are woollen cloths of close texture, resembling machine blankets, and are larger than the paper placed upon them. Upon each sheet of paper a third worker places a felt, and the papermaking proceeds. When the pile of felts and paper is sufficiently high, it is transferred to a hydraulic press, and considerable pressure is applied in order to remove as much water as possible by squeezing, and, more important, to couch or press the fibres together and to close the sheets. The pile is removed, the felts taken out, the pile of paper replaced in the press and given further pressing, and for some papers the sheets are turned, rebuilt, and pressed again, to improve the closeness of the paper. The paper is then taken to

the drying loft, hung on ropes of cow hair, which material possesses the virtue of making no marks or stains upon the tender paper. Alternatively hand-made papers may be laid out in large canvas drying trays. Loft-drying is carried on at an even temperature, in order to permit of even shrinkage of the sheets. At this stage the paper, which is unsized, is known as waterleaf, and unless it is to be used in the unsized state, requires further treatment before being ready for use.

Mould-made paper, as far as making the sheets is concerned, is made on a cylindrical mould revolving in a vat of pulp, all the other operations being carried out as for hand-made papers.

PAPERMAKING BY MACHINE

The Fourdrinier machine bears the same relation to the hand mould that the rotary press does to the hand press. Instead of making paper sheet by sheet, it is made in a continuous web, on an endless band of woven wire. The machine in a much simpler form was invented by a Frenchman, Nicholas Robert, the first machine being made in 1799, and so rapidly did the machine find favour that in fifty years over 150 paper-making machines were at work.

Papermaking by hand involves the processes of transferring a certain and regular quantity of pulp from the vat to the mould, shaking the mould to felt the fibres and to remove the water, couching the paper and drying the waterleaf. Machine-made paper follows the same processes exactly, everything being done by the

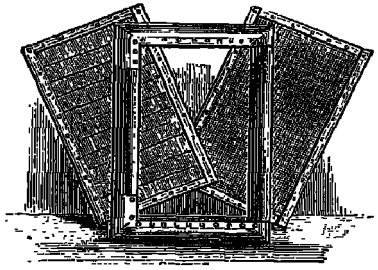


FIG. 7.—HAND MOULDS AND DECKLE.
(Laid and Wove Moulds.)

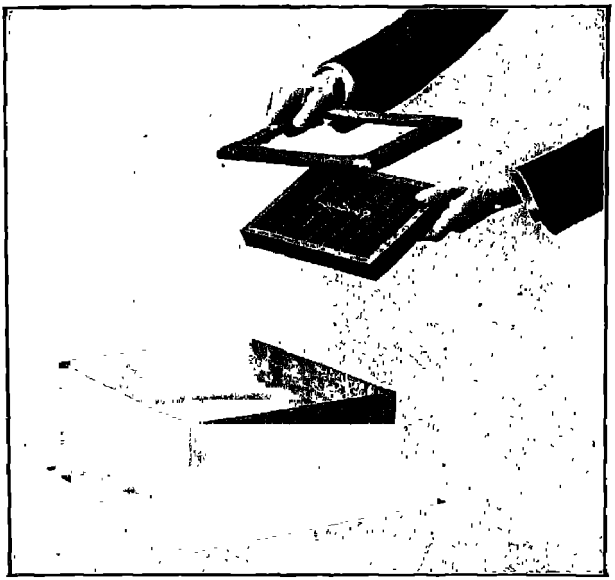


FIG. 8.—METHOD OF MAKING SMALL SHEETS ON HAND MOULD.

[*To face p.* 16.

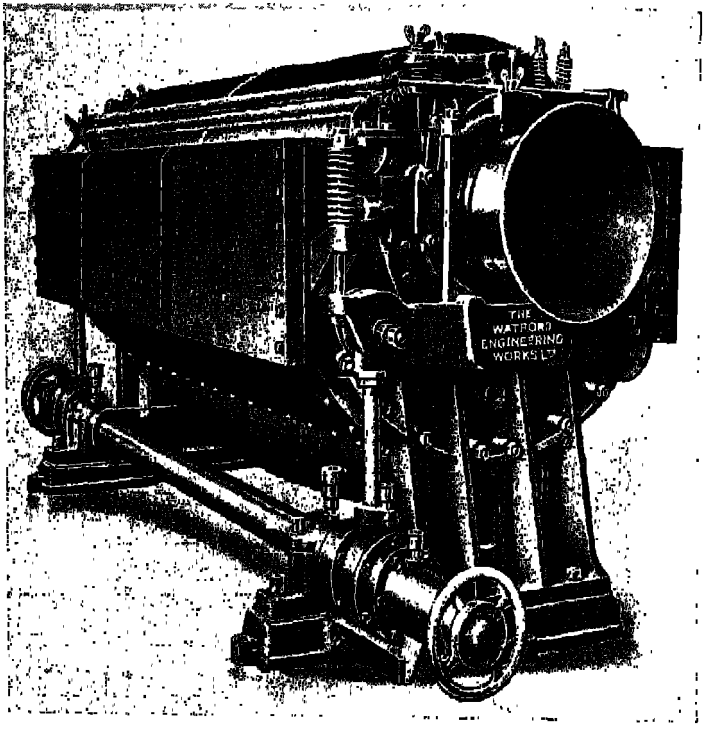


FIG. 9.—REVOLVING STRAINER: INWARD FLOW SUPER-TREMOR STRAINER.
(*The Watford Engineering Works Ltd.*)

[*To face p.* 17.

one machine, including sizing. Viewing the papermaking machine, it appears to be a collection of machines carrying out the separate functions in proper sequence. The different parts of the machine can be controlled and driven at different speeds for special reasons. Thus a definite and regular quantity of pulp is furnished to the wire (the travelling mould), the wire is shaken, the water removed, the soft paper couched, pressed, dried, and a finish given to the surface of the paper, all in the compass of the one machine.

The pulp as described on p. 12 was merely beaten fibre, and if an unsized paper were required the pulp would be let down to the stuff-chest; but usually other things are added before the pulp is ready for the machine. Filling or loading, colouring matter and sizing material, are mixed with the pulp, thoroughly incorporated, and then the engine is emptied. Paper can be made without filling or loading; in fact, all-rag papers seldom contain mineral matter, and many excellent papers are made from other fibres without loading. The purposes of fillings are to fill the spaces between the fibres, to give opacity to papers, such as those made of sulphite wood pulp, which would otherwise be very transparent, and to enable the paper to take a higher finish than would be possible in a paper without filling: a smoother and more absorbent, even if a little weaker, sheet resulting. In a rag blotting paper, mineral matter would be an adulteration; in writing papers 5 per cent. is sufficient for improvement of surface; in printings 10 to 16 per cent. is as much as is permissible. In an imitation art paper as much as 25 per cent. may be added, and yet a serviceable paper result; but of course the tenderness

of imitation art paper will be present. China clay is the usual material used for filling or loading. It is mixed with water, and strained before filling into the beating engine, and the colour is added, either to produce a coloured paper, or to correct the tendency to greyness in the finished paper. In the latter case, a little blue and perhaps a little red is added, while in the former case the colour may be added, or formed *in situ* by the mixture of different chemicals in the beating engine. Dry colours, whether pigment, as ultramarine, or aniline colours, are mixed with water (dry patches being difficult to deal with in the pulp), and then added to the engine; when the colours are thoroughly mixed, alum is put in. This serves to mordant or fix the colour, and also serves to precipitate the rosin size which is next added. There are various prepared sizes on the market to take the place of the size prepared by the papermaker from rosin and a solution of soda. The rosin is melted and added to the soda solution, and boiled until the solution is complete. The size solution is added to the pulp in the beating engine, and the paper is an engine-sized paper.

The pulp now consists of innumerable fibres, to which and in which are fixed small particles of china clay, colouring matter, and rosin. In many writing papers a small amount of starch paste is added, and that also adheres to the tiny fibres. The engine is emptied by gravity into the stuff-chest, where the revolving arms keep the fibres in the mixture from precipitation. Then there is a short journey to the machine, during which the pulp undergoes great tribulation, first being diluted with a large quantity of water,

then passing over sand traps which intercept grit, metallic fragments, and such matter that is heavier than the pulp and so tends to sink, and then through strainers, which retain foreign matter, unbeaten particles, and knots of fibre. The flow of pulp is governed by a system of valves, which can be quickly manipulated to alter the substance of the resulting paper.

Additional apparatus is employed for some classes of paper to remove impurities and unwanted bodies by means of centrifugal treatment of the stuff. Proprietary names of some of the apparatus available are the Erkensator, the Purifuge, the Vortrap, and the Assablador.

The wet end of the machine consists of an endless band of woven wire, some 40 to 80 meshes to the inch, from 48 in. to 300 in. wide, and a total length of 40 ft. or more. The length of wire in use at one time as a paper mould is less than half its total length. This woven wire corresponds to the mould of the vatman in hand-making. Deckle straps, the substitutes for the vatman's deckle, are thick endless rubber bands, square in section, which rest on the wire cloth, and, following the travel of the wire, return over pulleys, serving the same purpose as the deckle, namely, to confine the pulp to the wire surface. The wire cloth is supported by a number of rollers—tube rolls—which keep the wire from oscillating, and assist the passage of the water through the wire. The end of the wire nearest the stuff-chest is oscillated at right angles to the direction of travel in order to cause the fibres to felt before the water has passed through the wire. The pulp passes from the strainers under a sluice, which distributes the pulp evenly over a rubber apron,

on to the machine wire, and near the end of the wire is a cylinder of the full width of the machine wire, covered with woven wire, and below are two or more square boxes also the full width of the wire. The cylinder is the dandy roll, which closes the surface of the paper with slight pressure, and if a watermark is required the soft pulp is impressed by the design upon the surface of the roll. If the paper is to be "laid," the cylinder will be covered with laid wires, with tying wires at regular intervals. The "laid" markings on such a paper is really as much a watermark as the lettered designs. A dandy roll on which the tying wires run the length of the roll instead of round the circumference is known as a spiral-laid dandy roll, the laid lines being marked by the wire which is wound on the dandy roll as a spiral. For wove papers a woven dandy roll is employed which leaves no mark beyond any design that may be above or below its surface. The boxes beneath the wire are suction boxes: open mouths of pumps which extract more water from the paper. The wet end is well named, as for every ton of paper nearly 20,000 gallons of water are used for the dilution of the pulp, so that it may flow evenly and regularly. This water passes through the wire, most of it falling into the save-all and is used again for diluting the pulp. Passing under the dandy roll and over the last suction box, the wire carries the web of paper through the couch rolls, where the paper is couched or pressed by a felt-covered roll for the same reasons that hand-made papers are couched: to remove water and to consolidate the paper. The wire returns to perform its operations continuously, and the limp paper is carried forward to

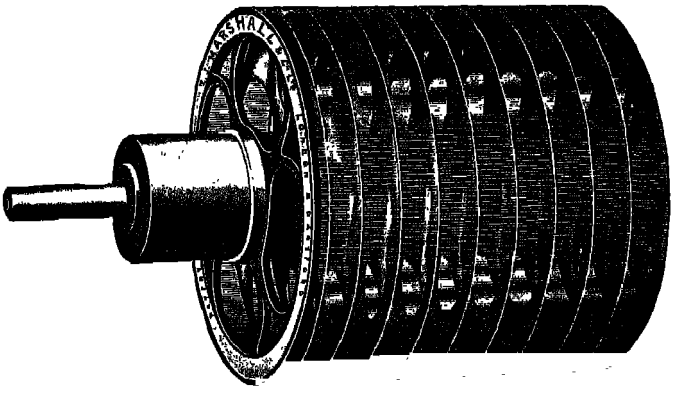


FIG. 10.—END OF LAID DANDY ROLL.

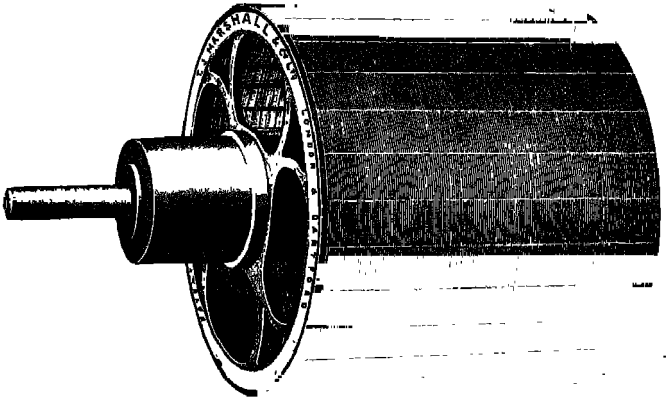


FIG. 11.—END OF SPIRAL LAID DANDY ROLL.

[*To face p.* 20.

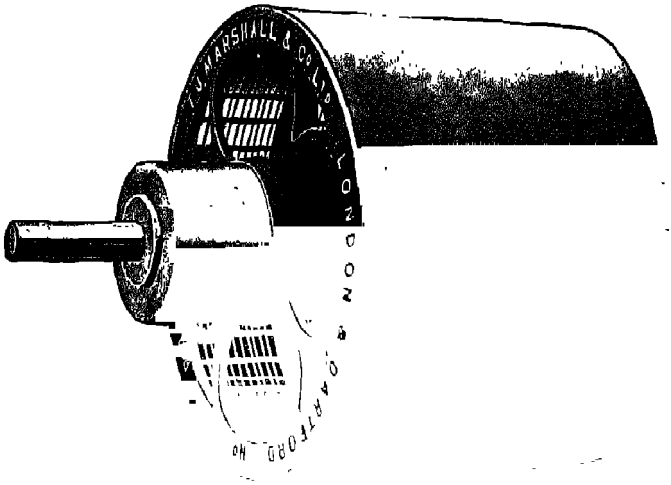


FIG. 12.—END OF WOVE DANDY ROLL.

[*To face p.* 21.

the press rolls, where it is further pressed by polished rollers, first on one side, then on the other, to remove the wire and felt marks. Then the paper goes forward to the drying cylinders—massive rolls internally heated by steam; but the heat is so regulated that it is gradually increased, and the speed at which the web of paper travels is arranged so that no undue tension is placed upon the paper, or thinning might result, or the web be broken, and delay caused. The drying section of the machine is a very quiet place compared with the wet end. At the end of the machine are stacks of rolls through which the paper is led if it is to receive what is known as "machine finish." If, however, the paper is to be super-calendered, it is led past one or more of the stacks of rolls, and as it is reeled off, a fine spray of water is projected upon the paper. There are various means of producing a misty cloud, but the object is the same in every case, to restore some of the moisture which has been driven off, and to prepare the paper to receive the finish at the super-calenders. If the paper were finished bone dry it would not be possible to impart the required surface by super-calendering, and the paper would at the first opportunity absorb moisture from the atmosphere, and various troubles would arise. The paper, now reeled, is ready for the finishing department.

Variations in manufacture on the Fourdrinier machine are seen in the production of papers consisting of two or more plies. There are several reasons for this method of manufacture: thick, strong papers, thick pulp boards, printing papers without wire marks, insulating papers with absence of pinholes may be made by moulding one or more additional webs on

separate moulding units, and bringing the webs together before or at the first press roll. Efficient adhesion of the separate layers requires careful adjustment of such factors as the raw materials and water content, and drying the compound web is not so simple as that of a single web. By bringing the wire sides of the webs together and finishing as a single web, printing papers are produced having two surfaces which would normally be the right side of such papers, and there is no underside to the papers. There are limits to the substance producible as laminated paper. It is not economical to make very thin papers in this manner, and thick boards are more easily manufactured in the methods which are described under the heading of Boards (p. 31).

Improvements in machine wires enable papermakers to manufacture printing papers with such slight differences between the two sides of the sheet that it is possible to obtain papers in which it is difficult to distinguish between the right and wrong sides of the sheet.

For the removal of water on fast-running machines suction couch rolls are sometimes employed, the top roll being then dispensed with. Further developments in the machine are in the direction of introducing suction press rolls.

Papermaking on the Yankee or single-cylinder machine is conducted in the same manner as on the ordinary or Fourdrinier machine as far as the wet end is concerned, but the series of drying cylinders is replaced by a single cylinder, 8 to 14 ft. in diameter, with a highly polished surface. The paper, being pressed upon the surface of this heated cylinder, is

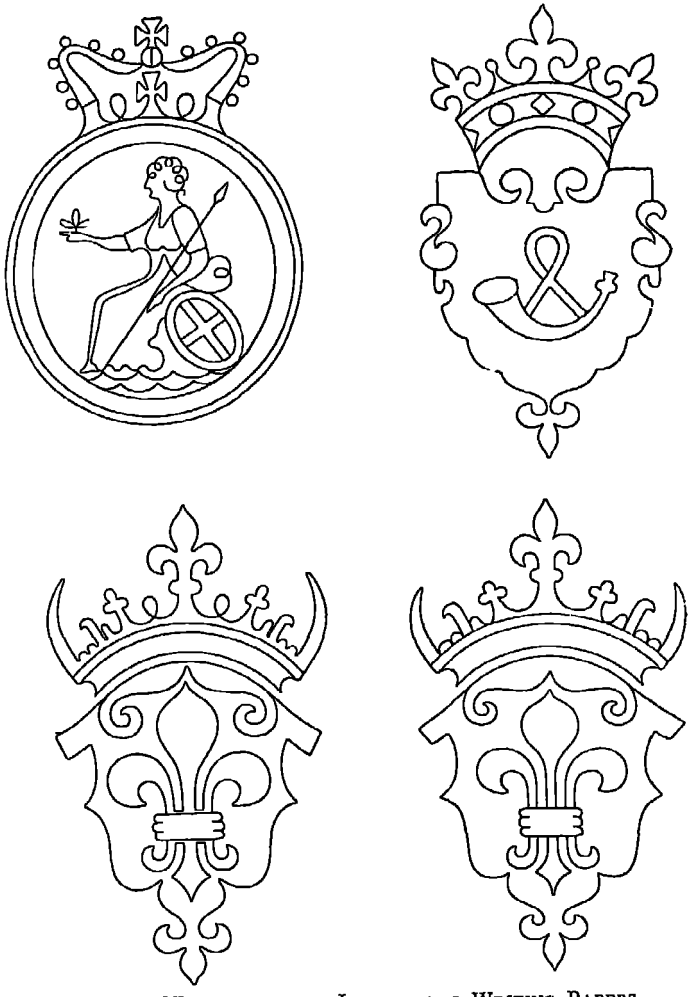


FIG. 13.—WATERMARKS OF LEDGER AND WRITING PAPERS.

Foolscap. Large Post.
Medium. Demy.

(Reproduced from Drawings supplied by Messrs Green, Son, & Waite.)

[*To face p.* 22.

FIG. 14.—WATERMARKS OF LEDGER AND WRITING PAPERS.

Royal. Super Royal. Imperial.

[*To face p.* 23.

dried and glazed on one side, hence the term M. G., or machine-glazed paper.

Felts which support the web during transference to the drying cylinder may be plain or ribbed (straight or diagonal), and as the moist web is pressed upon the drying cylinders by a rubber roller the ribbing of the felt is impressed upon the paper.

Mill numbers survive from the time when all mills were registered, and when paper was a dutiable article. The duty was repealed in 1861, but the mill numbers remain, and are additional to watermarks in distinguishing between papers of the various makers.

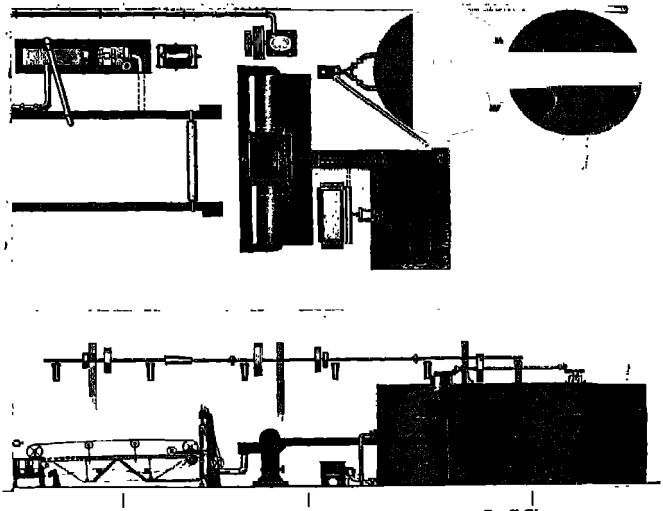
Watermarks have been used from very early times to serve as marks of distinction. The watermark used by John Tate of Stevenage in 1494 was an eight-petalled flower. The cap and bells, post horn, crown, fleur-de-lis, and tankard have been associated with foolscap, post, crown, royal, and pott respectively, but the connection between size and watermark is not very close. At present foolscap papers frequently bear the figure of Britannia, and royal papers a shield, with bend sinister, surmounted by the fleur-de-lis. The register of watermarks consists of a large number of names which are intended to make the papers bearing them proprietary articles, and as the quality of the paper is maintained by the papermaker, there is an indirect virtue in watermarks. Special watermarks are sometimes designed for special editions or for paper for special purposes, the dandy roll being made in length and diameter to suit the size of the paper to be made. Watermarks on hand moulds are placed in position on the moulds, and the difficulty of obtaining

register of the marks does not arise as it does when cutting machine-made papers from the web.

FINISHING

The formation of the sheet or web of paper is followed by various processes which are covered by the general term of "finishing." Hand-made paper requires sizing, drying, glazing, sorting, counting (sometimes cutting), and packing before it is ready for dispatch. If the machine-made paper is for writing, it may be gelatine sized, followed by drying, re-reeling, glazing, cutting into sheets, sorting, counting, and packing into reams. Printing papers are finished either with "machine" or with supercalender or water finish, and other papers with friction-glazed or flint-glazed surfaces, and the operations of sorting, counting, and packing follow as for other papers after glazing.

Tub-sizing always means animal sizing. Some mills still prepare their gelatine from hide cuttings, parchment cuttings, and other materials which yield gelatine, but the tendency is to eliminate this process and to buy the gelatine in sheet form ready for use without any process other than reduction to a solution of such strength as is necessary. The tub or vat of size is prepared and kept at an even temperature, the paper is dipped or allowed to stand in the size, or there are machines which carry the paper slowly through the trough of gelatine. The size must permeate the paper in order to make the sizing effective. On emerging, the paper is squeezed to remove the excess of size,



Wid
Leng TRAMS LIMITED.
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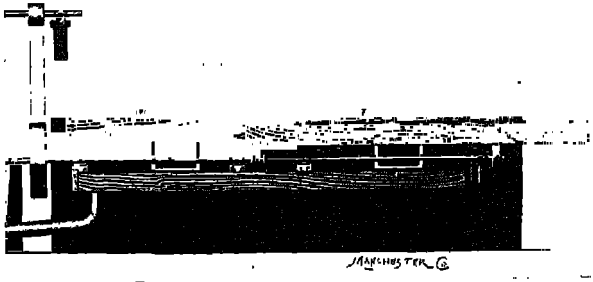

[*To face p.* 24.

and the sheets are separated to prevent the paper from becoming a solid block.

The second visit to the drying loft prepares the paper for the last stages of manufacture. The drying is conducted at a moderately low temperature (for papermakers), not exceeding 90° F. Loft drying permits the stabilisation of the paper without tension, tending to produce paper in which the ratio of strength in the two directions of the sheet is more nearly equal than in the case of papers dried under tension. When dry the paper has its bulk reduced and its surface improved by plate rolling, unless it is a drawing paper with a " not," that is, a rough surface. Plate rolling necessitates building a pile of paper, alternated with polished zinc plates a little larger than the paper, unbuilding and building of piles proceeding simultaneously as in the case of taking out set-off sheets and interleaving newly printed work. One girl takes the glazed paper, a second removes the plates, a third feeds the unglazed paper to the plates. When the pile is high enough it is lifted to the pressing rolls by a man who feeds it between the rollers, where great pressure is given, and the pile automatically returns to the front of the machine, and it is turned and placed for pressing the other way of the sheet. From two to a dozen pressings will be given according to the degree of finish required, and also to the hardness of the material.

Sorting, counting, and packing complete the cycle of operations included in finishing, unless cutting to size is also necessary. Girls stand at long benches lighted with large windows, and have piles of paper before them for sorting into three classes—good, middling, bad—according to the degree or absence of

defects. The middling paper showing slight defects is known as "retree," the reams are marked × ×, and the paper is sold at 10 per cent. reduction on the price for good paper. Bad paper, showing glaring defects, is called "broke," the reams are marked × × ×, and it is either sold at a further reduction or is returned to be re-pulped. If the order is for specially watermarked paper, or is for all "insides" or good paper, the "retree" and "broke" will both return for re-making.

Machine-made writing papers which are to be sized with gelatine are usually first sized with rosin, so do not come forward as waterleaf. The sizing room is long, high, comparatively narrow, containing a small sizing machine and numerous skeleton drums. The reel of paper is mounted on brackets in front of the sizing trough, the web passes between metal rollers, beneath the surface of the warm size, out and between squeezing rolls which remove the excess of gelatine, and then the paper is re-reeled or else passes directly forward for drying. Up to the roof and down to the floor, over skeleton drums, the web of paper travels until it is thoroughly dried, in a temperature equal to that of the drying lofts. At the end of the room the paper is reeled again, and when in a fit state goes either to the super-calenders, or, if the paper is to be plate-rolled, it is cut and the surface imparted as described for hand-made papers. Papers which have been so sized and dried are described as tub-sized, air-dried, but must not be confused with loft-dried papers.

There are special attachments to some papermaking machines whereby engine-sized papers are passed

through a small vessel of gelatine size in an interval between the drying cylinders, and, travelling over a few skeleton drums, continue through the remaining drying cylinders.

Papers which are merely to have "machine finish," that is, the surface imparted by the calenders of the paper machine, receive no further treatment before being cut into sheets. Those papers which are to be super-calendered (S. C.) pass through a large super-calendering machine, consisting of a number of chilled iron rolls and rolls of compressed cotton or paper alternately. The weight of the rolls is enormous, and although extra pressure can be applied, it is not often necessary. A very high degree of finish can be given by means of the super-calenders, and the majority of papers with a glazed finish have passed through this machine.

Papers which are to be "water finished" receive a film of hot water on the under surface just before the web passes between the calender rolls of the paper machine, and as a result the mineral constituent of the paper is brought to the surface, and a very level finish, with a high degree of polish, is imparted to the paper. The treatment is applied to both sides of the web.

Friction glazing produces a higher polish than the processes already described. The machine is simple in construction, consisting of two rolls only: a high-speed steel roll, which may be heated, and a large paper roll travelling at the same speed as the web of paper. The top roll burnishes the side of the paper against which it is driven in a much more effective manner than the super-calenders. To assist

in burnishing the paper an application of wax is made to the polishing roll.

Flint-glazed papers are actually burnished by the surface of a stone passing rapidly backwards and forwards on the surface of the paper as it emerges from the rolls, giving a hard brilliant polish. The same degree of finish is imparted to some papers by the use of a number of brushes oscillating rapidly upon the paper as it travels over a large cylinder.

Many writing and printing papers are now conditioned at the mill. This operation consists of passing the web of paper through a conditioning unit, where additional moisture is taken up by the paper, which leaves the papermaking machine with a very low moisture content.

Cutting the reels into smaller widths and then into single sheets is the function of a number of ingenious machines. If a watermarked paper is to be cut to register, a single reel is mounted at the cutting machine, and the web is advanced the necessary distance and the division into sheets takes place by a knife. An attendant watches the travel of the paper, and when the watermark travels beyond or short of a pointer, a turn of a screw brings the next sheet into register. Single sheet cutters are used for other papers, the reel is mounted, run forward between slitting knives, and a swinging knife divides the paper into sheets. Another make of machine will take from one to seven reels, and the paper passing between the slitters is cut into sheets by a revolving cutter, which makes a clean cut the whole width of the web, and the sheets are dropped on a travelling felt, carried forward to the front of the machine, where an automatic " layer " keeps the

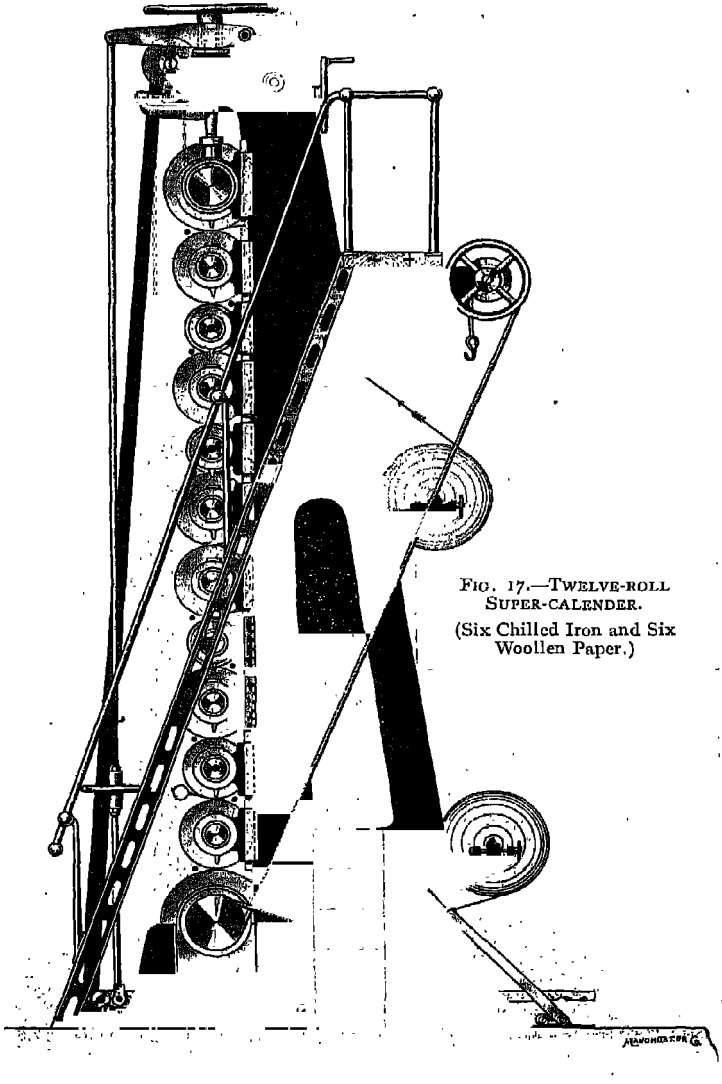

FIG. 17.—TWELVE-ROLL SUPER-CALENDER.
(Six Chilled Iron and Six Woollen Paper.)

[*To face p.* 28.

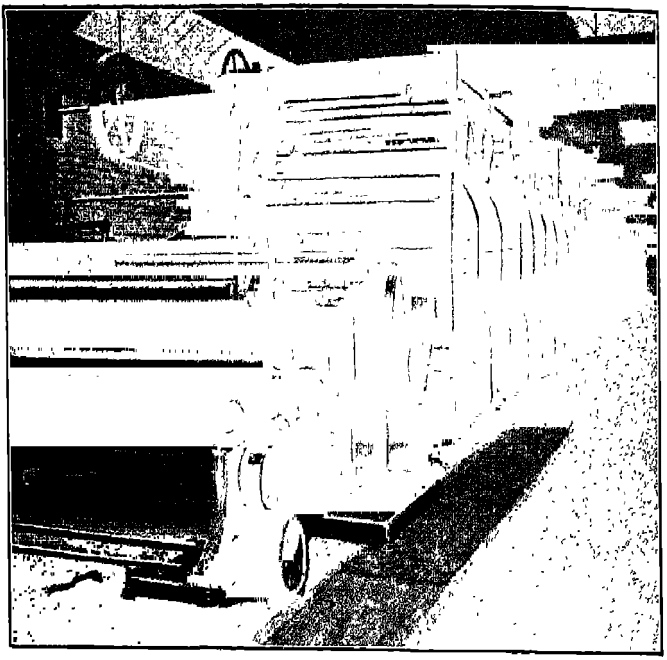

FIG. 18.—TUB-SIZING MACHINE (*Bertrams Ltd.*).

[*To face p.* 29.

piles knocked up. To prevent waste in cutting out blanks, envelope papers are cut at an angle, this being accomplished by swinging the frame carrying the revolving knife to the desired angle, and the papers are delivered in sheets ready for the envelope maker.

Duplex cutting is sometimes carried out when, for example, a making of paper 30 in. × 40 in. is made on a machine of 100-in. width. The paper is cut on a machine which slits the machine reel to two webs of 30 in. and one web of 40 in. width, and there are two revolving cutters, one cutting sheets 40 in. long (from 30-in. widths) and the other sheets 30 in. long (from 40-in. width). These cuts are packed separately.

From the cutting machines the paper is taken to the "salle"—the sorting and packing room of the paper mill. One of a number of girls rapidly examines every sheet of paper, withdrawing those sheets which fall below the papermaker's standard of perfection, sorting into retree and broke, proceeding as in the case of hand-made papers. Counting, cutting, and packing take place very quickly after the paper is sorted. The nimble fingers of the counter turn up the edge of a quantity of paper, the fingers of the other hand run down the edges quickly, counting into reams with extraordinary accuracy. Some papers are trimmed before packing, while others are cut from double to single sheets. Wrappers are carefully folded round the paper, and fastening is done by means of string, tape, or paper tape, according to the size and weight of the reams.

Labels affixed to the packets, either on the end, side, or top of the parcel, indicate the number of sheets, description of the contents, substance, size, and if

there is a proprietary name or watermark that will also be embodied in the label. Many mills now indicate the machine direction of the paper upon the wrapper.

As will be seen from "Paper Trade Customs," on p. 163, the number of sheets to the ream is a varying quantity. A ream* may consist of 472, 480, or 500.

In hand-made papers a mill ream consists of two grades of the same paper, whether the paper is bought as good or retree. If the paper is good it will consist of 18 quires of insides or perfect paper, each quire containing 24 sheets, and 2 quires of outsides or slightly inferior paper, these quires† containing 20 sheets each. "Retree" paper is marked on the outside by two crosses ××, and the mill ream will be 472 sheets, whether the paper be good or retree. A ream of insides consists of 480 sheets, and the price is usually 10 per cent. above that for a mill ream.

Machine-made paper is good, retree, and outsides, the prices being 10 and 20 per cent. less for the second and third grades respectively.

The latest Paper Trade Customs‡ provides for reams of 500 sheets of all papers other than hand-made and wrappings. The Master Printers' Federation has adopted 1,000 sheets as the basis of calculation of all material excepting wrapping papers, straw boards, and mill boards.§

A "parcel" of paper represents the entire making. A "bundle" has been used to designate two reams tied together. There are other methods of packing paper, to which special terms are applied. Lapped,

* Ream (rizmat—*Arab*) = bundle.
† Quire, *strictly* = folded in four.
‡ See p. 167.
§ See p. 168.

or rolled, indicates the method of packing a large paper, *e.g.*, 60 in. × 40 in. folding over the ends, producing a parcel approximately 40 in. × 25 in. "In and in" is another means adopted to render large papers easier to handle, and is effected by folding half the ream either across its length or width, and the other half is similarly folded and one fore-edge is placed inside the first half and the other fore-edge outside. It is to be recommended that large papers should be packed "in and in" *long folio* rather than across the shorter dimension, as if the paper stands for some time the transverse crease may form a ridge in the sheet and cause difficulty in feeding on cylinder machines.

To ensure large papers and papers of special character (*e.g.*, hand-made and coated papers) arriving at their destinations in good condition, they are frequently packed between frames or boards at the mill. For periodical work large quantities may be contained between boards which are held together by bolts instead of cords. Boards and frames are returnable carriage paid, and are credited in full if in good condition. Paper in reels is protected in various ways against damage in transit, heavy wrappers being necessary, and, if travelling overseas, protection by wooden cases and ends.

BOARDS

The manufacture of boards is varied, ranging from Bristol boards to mill boards, and including ivory boards, paste boards, triplex boards, straw boards, and pulp boards.

For pulp boards the description of papermaking will serve in its entirety, as the boards are made on the Fourdrinier machine, being engine-sized, reeled at the end of the machine, well rolled later, cut into sheets, sometimes plate-glazed after this, and then sorted and packed. There is one point of variation only, and that is in speed. As there is much more "stuff" let down to the wire, more time is required for removal of the water from the greater thickness of material on the wire, and so the output is relatively slower than when paper is being made. Thick pulp boards of the character of imitation art are made in two webs (on two separate Fourdrinier wires), brought together after the couch rolls, and finished as one web.

For ivory boards, two or more reels of fine paper made on a Fourdrinier, or else on a cylinder machine, are pasted together with starch paste, and the web is highly rolled.

Cylinder machines are invariably used for duplex, triplex, and boards of several layers other than paste boards and those already described. Instead of a travelling wire, a wire-covered cylinder is the means of forming the web of pulp. The cylinder revolves in a vat of pulp, takes up a thin layer of the fibre, and, pressing against a travelling felt, leaves its film of pulp, and as there are several cylinders, each in its own vat, producing layers in the same way, the several webs are brought together, rolled, dried, and reeled. In the case of a two-ply board the pulp may be the same colour, or of two different shades. In triplex boards, the outsides are frequently thin and different in colour, compared with the middle sheet. Cylinder machines with as many as seven vats are in use, and

forty to fifty drying cylinders are necessary to complete the extraction of the water. The multi-cylinder machine is employed for the manufacture of box boards of all kinds, and also for leather boards.

Leather board is the title given to a tough variety of box boards. A special class of mechanical wood pulp is employed. A characteristic colour is given to the boards.

Paste boards are made up from middles and pastings. These are obtained from mills making specialities of each of these lines, the middles very often consisting of a moderately thick paper of poor quality, but the outsides are of fairly fine paper. The papers are not glazed, but after pasting together the web is thoroughly rolled and the surface obtained by subsequent calendering. Bristol boards are made from the finest materials —all-rag, tub-sized papers, the same paper throughout, pasted, pressed, and surfaced by hot pressing. Other boards supplied under this title are made of good drawing paper for outsides, and cartridge for middles. The best boards are made by hand, and demand considerable time and care in manufacture.

Mill boards, slate boards, portmanteau boards, and carriage panels are made on a special board machine. For these boards a large variety of materials finds its way to the machine, such as waste in the form of flax, ropes, coarse rags for the best qualities, and for the lower grades waste papers of all kinds. The stronger materials are boiled and beaten, bleaching being unnecessary. Waste papers are simply steamed and pulped. All materials are strained, diluted with water, and forwarded to the vat or stuff-chest of the machine. The board machine is comparatively

short, consisting of a cylinder which lifts the film of pulp, delivers it to the endless felt, and a cylinder at the other end of the machine receives the web, which continues to build up until the desired thickness is attained, when the wet board is dexterously slit by the attendant and taken off to the pile. Here the boards are alternated with sheets of felt or canvas, and the water is pressed out. The boards are hung up singly to dry in a heated chamber, and are afterwards damped slightly, rolled heavily, and cut to size.

Strawboards are made upon Fourdrinier machines for thin substances, and on cylinder machines for boards of medium thickness. Thick boards are built up from boards of medium substance, a cement of sodium silicate usually being adopted for ensuring rigid boards.

SECTION II

PAPERS OF VARIOUS KINDS

WRITING PAPERS

A LARGE variety of papers falls under the heading of writing papers: account book, bank, bond, cheque, ledger, loan, and typewriter papers being placed in this category. The printer uses writing papers of all kinds, some as superior printings, and others he prepares as stationery, or prints some part of a document upon them for subsequent filling in or completion.

Writing papers must be smooth and hard-sized to fulfil their purpose of bearing writing ink, and other qualities will depend upon the use for which they are destined. The fibres used include rag, chemical wood, esparto, and, in the poorest qualities, which but few printers or stationers will stock, mechanical wood. Writing papers of the highest class are all-rag, tub-sized, air-dried, and plate-glazed. Every variety of writing paper may be wove or laid without alteration in quality; in fact, most mills make woves and laids from the same stuff, merely changing the wove dandy roll to one which makes the laid marks on the paper. This first grade of paper is used for the best stationery, for printed and written documents of the highest importance which are required to stand a good deal of

handling, and for ledgers and similar books subject to hard wear. Hand-made paper is used for some bank notes, while the papers for stamps, cheques, postal orders, and money orders are usually machine-made.

Bank notes, loans, and banks demand the use of the strongest rags, such as linen, duck, and sailcloth. The fibres are drawn out rather than cut up, the resulting paper being hard and resistant to wear. Bank notes are cream wove; banks, cream wove or blue wove; loans are cream wove.

Ledger, or account book, papers may be hand or machine made, and are usually azure or blue laid. If machine-made, the characteristics of the hand-made papers are as far as possible retained: strength, hard tub-sized surface, opacity, moderate finish, both sides alike in surface. To attain these qualities the same materials are employed, an all-rag furnish with a fair proportion of strong linen, prolonged beating to draw out the fibres, a shake which will ensure good felting, slow drying to allow of gradual contraction, tub-sizing, air-drying over skeleton drums will attain the desired end. The finish of ledger, or account book, papers is not quite so high as that for loan papers, but it must be equal on both sides of the sheet, in order that writing may be done easily on all pages of the books. The sizing must be thorough, or the ink will sink through the paper, and if erasures are made, the abraded surface will not take ink without spreading.

Machine-made bond or loan papers are not always all-rag papers, and are not essentially tub-sized, but the best of the class will be all-rag, tub-sized papers. One paper mill carries an enormous stock of high-class engine-sized bond and bank papers in fifty-seven

shades, and each of these in five substances. Bank papers are thinner than bonds, the usual substances being 45 grm. per square metre (foolscap, 14 lb.; large post, 22 lb.; medium, 26½ lb. per 1,000 sheets). Here, again, the best papers are all-rag, tub-sized, and while very good chemical wood, tub-sized, super-calendered bank papers are obtainable, rag papers of the best quality always command a high price, being extremely strong and durable. Typewriting papers are similar to bank papers, but usually have a matt finish to prevent the smearing that may always take place on a highly polished paper, as the type-written characters are not indented into the paper, but the colour is on the surface. Watermarked typewriting papers are well known, and the prices vary according to the substance and fibrous constituents of the papers, thin papers (16 lb. per 1,000, large post *) costing nearly twice the price per lb. for which papers of ordinary substance (32 lb. per 1,000, large post †) can be purchased.

Cheque papers are strong, even in texture, and present a good surface for printing. There is a fair range of papers to choose from for cheque printing, without taking into consideration safety cheque papers.

As the same pulp may be employed for the production of wove or laid papers, so may the colour be varied without changing the quality. Cream wove, blue wove, yellow wove, cream laid, azure laid, blue laid, or tinted papers may be made from the same stuff, the colouring matter added giving

* 32½ grm. per square metre.
† 65 grm. per square metre.

the necessary difference in tint, the description of the paper varying accordingly. There are, of course, certain cases where one or other is preferred, but the quality is neither indicated by the colour of the paper nor by the pattern of the dandy roll employed. The surface may be rough (antique), moderately smooth (machine finish, vellum, ivory), or highly glazed (plate-glazed or super-calendered), each being attained by the different treatment in finishing the paper. Papers made entirely of rag will always be tub-sized, air-dried, and frequently plate-glazed, but papers which are only partly rag, and even chemical wood papers, are sometimes tub-sized, but as a rule papers which contain no rag fibre are sized in the pulp, that is, engine-sized. The large variety of high-class engine-sized papers now obtainable is at once creditable to the enterprise of the manufacturers, and a sign that papers of this description fulfil the requirements of a large body of consumers.

A large quantity of writing paper is used for printing, from which it might be inferred that there is a close resemblance between printings and engine-sized writings. The sizing of writings is harder than that of printings, and the materials used are manipulated to give a firmer handle to the paper, but there is no reason why many writing papers should not be used as printings in work of the character of booklets, magazines without illustrations, and a large part of the jobbing work which keeps to leaflet and pamphlet sizes. The nature of writing papers makes them less absorbent than printings, so that the ink does not sink into the paper quickly. This is a desirable characteristic in the case of writings, but not in the case

of printings, where a fair absorbency aids the rapid drying of printed work.

Drawing papers are made in various qualities. The best kinds for water-colour drawings are made from strong rags, chiefly linen, only boiled to remove dirt and other impurities, and reduced to pulp without the use of bleach or other chemicals. Hand-made papers are the best, being tub-sized, loft-dried, and the surfaces—rough, "not" (matt), or hot pressed—obtained by pressure, not by rolling. A few high-class mills are responsible for machine-made drawings similar in furnish and finish to those made by hand. Engine-sized drawing papers are more like cartridge papers, but some of the cheaper varieties resemble thick toned printings. Cartridge papers are made from long-fibred stuff which is only partly bleached. Some cartridge papers are tub-sized and serve as substitutes for drawing papers. Being very strong, they make excellent cover papers for books and lists of various kinds. Crayon papers are coloured or tinted drawing papers used for crayon and water-colour work.

PRINTING PAPERS

There is considerable variety in printing papers, as regards fibre, sizing, and surface. As generally understood, printings are papers of good colour, not too hard-sized, of good surface, even in texture, fairly opaque, showing a clear look-through, free from specks and spots. The fibrous composition will depend largely upon the price. An all-rag paper is a splendid white paper, soft to print upon, pleasant to handle, very

durable, and a type of moderate colour printed with a good black ink gives a very rich appearance on such paper. Hand-made, Dutch hand-made, cylinder mould-made, and machine-made rag papers are the papers for very special editions. Special moulds or dandy rolls are sometimes made for these papers to secure a distinctive appearance.

High-grade printing papers are produced from a mixture of rag and chemical wood fibres, a soft paper, taking a good finish, being produced. A blend of chemical wood and esparto, skilfully manufactured, produces a very good printing paper for all ordinary purposes, and papers composed entirely of chemical wood may be good or indifferent, according to the treatment and skill devoted to their production. Sulphite papers tend to be harsh and transparent, but a mixture of soda pulp partly counteracts these faults, and even if it is not quite as soft as an esparto mixture, excellent results in printing can be obtained if the fibres have been carefully beaten and blended. Papers containing mechanical wood are classed as common printings, and are suitable only for common work. A small proportion of mechanical wood may not be noticeable in the finished paper, but when a large proportion is used, greyness of colour and poorness of appearance are sure indications of the low quality of the material. Hand and mould made papers have no mineral filling in their composition. For machine-made papers the addition of a small proportion enables them to take a very good finish. The amount of china clay present in the finished paper should not exceed 16 per cent. of the total weight.

Hand-made and mould-made printings are tub-

sized and plate-rolled, without giving a high glaze to the paper. Machine-made printings are engine-sized, hard or soft according to the use to which the paper is to be put, and sometimes the surface will govern the sizing, some papers being hard-sized and super-calendered, others soft-sized and with only machine finish. As a matter of fact, super-calendered printings are used largely for illustrated work, and with half-tone blocks the ink must dry thoroughly and fairly quickly, so the paper is not hard-sized. All thin printings require to be well sized to prevent the ink sinking right through the paper, and most papers with machine finish, excepting the commoner news, are usually well sized, and coloured printings, too, incline to hard sizing.

The best Bible papers are made of rag fibres with a fair amount of loading, and some starch to ensure opacity and good printing qualities. The Oxford India paper is still manufactured under special conditions which are kept secret, but there are many imitations which serve excellently for the purpose of thin paper editions. The graphic demonstration of the difference between the thickness of the "Encyclopædia Britannica" printed upon India paper and ordinary printing paper will furnish an object lesson in the utility of such papers.

Toned papers are made of the same materials as white paper, the creamy colour being obtained by the addition of a small amount of colouring matter to the pulp.

Featherweight papers are made entirely of esparto, very little sizing is added, no loading is used, the paper is treated so that the wire and felt marks are not easily visible, and the drying and finishing are carried out so

as to retain the bulkiness of paper. It must always be remembered that all papers made under such conditions are not durable, and therefore should never be used for work which must withstand any considerable handling.

Coloured and tinted papers are made of the same materials as white printings, but usually the fibres will be chemical wood and esparto, all chemical, or a mixture of chemical and mechanical wood pulps. The variety of tints in which papers can be obtained is very extensive, and this is impressed upon one when trying to match up some particular shade, when it appears as though makers have many substitutes for the desired colour. The colours of papers should be fairly fast to light, and with the large variety obtainable by the use of the pigments and dyes now on the market, paper-makers manage to offer a long range of fast colours. Although it may not always be so, fastness usually follows the price of the paper, the cheapest being the most liable to fade quickly. Delicate tints are more expensive because of the necessity of a better quality of paper to take the colours evenly and cleanly. Coloured printing papers should be fairly well sized, well finished, and free from spots and specks.

In addition to possessing the good qualities of printings, lithographic papers must be firm and free from permanent stretch. In letterpress printing, only a portion of the paper is pressed by the printing surface, but in lithography the whole of the paper is brought into contact with the stone or other surface. If the printing surface is full or solid, as in the case of printing a ground tint, the pull on the surface of the paper is considerable, and unless the paper is well made the surface will pluck or pull up in patches, or even all

over the sheet. Moisture from damping and from the atmosphere induces expansion of the sheet. Lithographic papers require special care in selection of material and manufacture, so as to introduce and preserve all the necessary qualities of easy printing, perfect register, and quick drying.

Esparto fibre is short and soft, prints easily, and experience has proved that esparto papers expand less than most other papers, and therefore litho. papers usually contain a large proportion of this useful material. An all-rag litho. paper is the first quality; then rag and esparto, all esparto, chemical wood and esparto, mark the various grades of paper for lithographic printing. While the papers should not be hard-sized, they should not err in the other direction, or absorption of moisture may cause trouble when registering. Soft materials, beaten quickly, dried gradually, not drawn too fast by the drying cylinders, are necessary to produce a satisfactory paper. The surface must be perfectly smooth, and this is obtained by super-calendering or plate-glazing, both of which tend to reduce the liability of the papers to stretch. The latter method is the better but more expensive method of producing the desired surface, and by turning the piles of paper and rolling in each direction of the sheet, subsequent alteration in dimensions during printing is reduced to a minimum.

Of recent introduction are the papers to which the name of off-set cartridges is given. Some of the papers have the character of a carefully made but fairly smooth cartridge paper. Others are of moderate substance, but resemble machine finished lithographic papers. All this class of paper, however, is well sized,

and serves for the many varieties of work executed by off-set lithography.

Plate papers are fine papers, soft-sized, lightly rolled, usually having one side only with a smooth finish. Thick plate papers are made by rolling two or more webs of wet paper together, and finishing as usual. The softness of the paper enables it to take all the ink from the finest lines of the steel or copper plates printed upon the surface.

M. G. papers for lithographic or letterpress printing are made on the single-cylinder machine, and, having only one side glazed—the printing side—are known as machine glazed.

Imitation art papers are distinctly between super-calendered printings and art papers in printing quality, but they lack strength, owing to the method of their manufacture. Art paper has a mineral coating, while imitation art has a large percentage (about 25 per cent.) of china clay mixed with the pulp. China clay, having no cohesion, does not assist in felting the paper in any way, but tends to weaken its resistance to wear. That weakness or tenderness is one feature of imitation art papers. At the end of the paper machine the paper may receive a water finish, that is, the web is wetted on the under side immediately before entering the rolls of the calender, and after one side is calendered the treatment is repeated for the other side of the web. The loading is thus brought to the surface, and a very smooth level sheet is produced, with a printing surface only a little inferior to art paper. Most imitation art paper, however, is super-calendered, and the water finish is simulated as closely as possible. Being opaque, suitable for half-tone printing, and of

good appearance, imitation art is used largely for illustrated magazine work, and serves the purpose well, but it should be remembered that the large proportion of mineral matter renders the paper liable to disintegration from frequent handling.

Coated papers comprise those to which, after manufacture as paper, a mineral coating, white or coloured, is applied, in order to produce a smooth unbroken surface for the reception of fine printed work. Art, chromo, enamel, and surface-coloured papers are all coated after the body paper is made.

Art papers may be made of rag, esparto, chemical wood, or chemical and mechanical wood, or a mixture of any of the fibres. The body paper is carefully made, its ultimate state being borne in mind, and it is fairly well sized, but without a high glaze. The surface is kept so that the coating will cover properly and the adhesive be fully effective in holding the mineral. The operations comprise coating, drying, and finishing. The coating is carried out on a compact machine. A mixture of white pigment, adhesive, and water is supplied at a constant level to the feed trough of the machine, from which it is transferred to the web of paper by means of a roller and felt; oscillating and stationary brushes rub the coating into the paper, filling up all inequalities and leaving a smooth film on its surface. The purpose of the coating is to give a perfectly smooth surface, obliterating entirely the marks of the machine wire and felts, and to do this effectively the consistency of the mixture is regulated so that it may enter the minute depressions and deposit sufficient matter to take a good finish. An ingenious overhead runway carries the web forward in a series of

festoons supported on a series of rods, hot air driven forward by mechanical fans effecting the drying. If the paper is two-sided art, it is reeled and the operations repeated on the other side of the paper. As the coating is slightly thicker at the edges of the web, these edges are trimmed off, and the web goes forward for one or more journeys through the super-calender rolls. Dull art and papers with a specially high finish receive slightly different treatment, the surface in all cases being made perfectly smooth in order that the finest half-tones may be printed successfully.

The demand for coated papers for illustrated periodicals has led to much research and experiment. As an outcome of these efforts several mills have installed coating plants at the end of the ordinary papermaking machine. The finished paper passes through a coating unit and is coated on both sides with a coating which is similar in all essential details to that described in the foregoing paragraph. Drying is quickly effected, and super-calendering completes the preparation of this kind of coated paper. Various proprietary names are carried by these papers. Several qualities and a number of substances of these coated papers are available.

Chromo papers are usually coated on one side only, and the body paper is stouter than that used for art papers. Used largely for lithography, the papers must be as free from expansion as possible. This is effected by using soft fibres, sharp beater knives, and cutting up quickly, this treatment producing what the papermaker knows as " free " pulp, as distinguished from " wet " pulp, which, owing to prolonged treatment, combines with some of the water and actually becomes " wet."

The surface of chromo papers may be dull or highly glazed.

Surface coloured enamelled papers are used largely by box makers, for labels for packets of various commodities, and also as end papers for books. The coating and body paper are thinner than for art papers, the colour is obtained by the use of a pigment or an aniline colour, and the coating and after-treatment are exactly as in the case of art papers. Flint-glazed surface papers are used for the same purposes as surface-enamelled papers, and have a hard burnished surface obtained by a stone burnisher travelling backwards and forwards across the surface of the paper as it emerges from the calender rolls.

COVER PAPERS

The evolution of cover papers from the ordinary wrapping papers is difficult to trace, despite the fact that mills which make brown and other wrappings generally produce one or more series of cover papers.

The materials used in their manufacture run through the whole range of papermaking fibres, the best qualities having a good proportion of rag fibre, while the low grades have some quantity of mechanical wood, but there should be little if any mineral matter present, as strength is an important feature. The finish of the papers is smooth, moderately rough, or rough; the colours tend to browns, greys, slates, and dark greens, but a fair number of more delicate shades can be obtained, and some of the reds are most effective. The substances of cover papers run from 65 to 240 grm.

per square metre, so there is sufficient variety from which to select paper to suit any job. The sizes of cover papers are a little larger than the dimensions of the papers to which they form covers, allowance being made for a book with a back of moderate thickness.

As covers for booklets, price lists, pamphlets, etc., cover papers are regularly used, and for other purposes there has arisen a demand for the darker shades. The army of photographers, professional and amateur, employ cover papers as mounts, either in the form of cut mounts or as photographic albums. For these purposes the range of substances has been extended, the heavy papers being made in card thicknesses. In making papers for photographic mounts a very necessary precaution is that the paper shall be absolutely free from chemical substances likely to affect the photographic prints mounted upon them. Colour prints are mounted on neutral cover papers for insertion in magazines or books, but when publications have extensive and growing circulations, the time and cost of mounting militate against this very effective method of displaying illustrations.

Embossed cover papers are made and finished in the usual manner, and run through special rolls having the pattern engraved upon them. Papers for embossing must possess good strength or the embossed design will not stand handling, or the paper may break when embossed.

Pamphlet cover papers are thick tinted papers, made in a very pleasing variety, serving as programme papers and for much jobbing work, as well as for the purpose for which they were originally intended.

" Pressings " are M. G. papers which belong to

the class of miscellaneous wrapping papers, and whether as simple pressings, or duplex pressings, quantities are employed as covers for exercise and similar books, any necessary printing being executed on the smooth side of the paper.

WRAPPING PAPERS

Wrapping papers are employed for every class of commodity, and there is a very wide variety in this section. Brown papers of all classes are readily understood as the largest constituent of the wrappings. Brown papers are made from a number of raw materials, many of which are unsuitable for other papers because of their colour, or other characteristic. Thus jute, in the form of old sacking or gunny bags, hemp refuse, old ropes, string, waste card cuttings, wood-pulp refuse, and waste papers furnish the fibres for brown papers. The best will be made from the rope fibres, and " washed rope " indicates that considerable trouble has been expended in removing dirt and impurities from the raw material. Air-dried wrappings, which include ammunition papers, are the highest grade and most expensive papers in this division. The special character of these papers is flexibility, and parcels which require frequent packing and unpacking call for such a paper.

Common brown papers are made from the commonest materials, including waste papers, and frequently it will be found that such papers have little strength. Thicker varieties made from low-grade material include mill wrappers, felt papers, firework

papers, grocery papers, papers for corrugating, and a variety of caps.

Nature browns, brown tissues, and ochre browns are commonly made from mechanical wood pulps with small additions of other fibres.

High-grade wrappings which will not discolour goods packed in them are necessary for such fabrics as cotton goods, and are made without added colouring matter. Strong M. G. papers are used for packing hosiery, and are known as hosiery papers. Pressings are other varieties of special M. G. packings, which are referred to also as cover papers.

With an increased supply of higher grade wrapping papers has coincided an increased demand. Papers made from special sulphate or sulphite pulps, sometimes with additions of mechanical wood, are obtainable in great variety. The highest grades of kraft * papers, made from special sulphate pulps, self-coloured, furnish wrappings in many substances, glazed, unglazed, or M. G., suitable for most wrapping and packing purposes. Sealings, either unglazed or M. G., afford packing papers suitable for stationery and other trades. These papers are obtainable in several colours, and the striped varieties are very popular. Bleached and unbleached M. G. sulphite papers are supplied in substances from 20 grm. per square metre and, although wrapping papers, serve for other purposes, notably for conversion into toilet rolls. The thinnest papers are known as sulphite tissues. Bag papers may be varieties of M. G. sulphite papers, either white or coloured, and in various substances.

Various wrapping papers having special character-

* *Kraft*=Strong.

istics are known by the nature of their ultimate purpose, such as cutlery browns, needle papers, seidlitz blue, and black photographic papers. Tea papers are papers of various colours, made from sulphite pulps, and with either glazed or unglazed finish.

" Parchment " may be glazed, unglazed, transparent, prepared for a variety of uses. Vegetable parchment, greaseproof, imitation greaseproof, and imitation parchment are varieties of wrapping papers used principally for wrapping foodstuffs and commodities which require protection from the atmosphere.

Waxed wrappings are made from a variety of papers—tissues, M. G. sulphites, imitation parchments, and others, used for wrapping many commodities from which it is desirable to exclude moisture.

MISCELLANEOUS PAPERS

Blottings and filter papers are very similar in appearance and manufacture, their definite purposes being to absorb moisture and to filter solid matter from solutions respectively. The description of blotting paper manufacture will cover both varieties. The office of blotting paper being to absorb ink, the raw material is chosen with a view to obtain the most efficient fibre for the purpose, soft muslins, too soft for writing papers, making excellent blottings. The preliminary treatment of the rags has been described already. Beating is carried out as quickly as possible, sharp knives being used to cut the fibres into short lengths, and not to bruise or beat the fibres more finely. As many fibre ends as possible must be absorbing on a given area at

one time, and the shorter the lengths to which the fibres are cut, the greater the efficiency of the blotting paper, within certain limits. Certain after-treatment of the fibre is resorted to, to produce as soft and absorbent a fibre as is consistent with the necessary cohesion, but, of course, manufacturers prefer to keep special methods to themselves. At the paper machine little or no shake is given, and very light pressure is given throughout, just sufficient to smooth the paper down. Strength is not aimed at, but the paper must be strong enough to resist the handling it will receive in ordinary use.

Most blotting papers are made in demy, with a standard weight of 80 lb. per ream of 1,000 sheets.* Esparto is sometimes used for blottings, with a proportion of china clay to assist in developing absorbency. Such papers are less durable than rag papers, falling off in effectiveness with prolonged use. There are blottings made of wood pulp, but these are far below the rag papers in efficiency. Wood-pulp blottings are usually made in thin substances for interleaving diaries and similar books, where repeated use will not be required. Enamelled blotting papers are made by pasting enamelled (coated) papers to the ordinary blotting paper and rolling down. These blottings can be obtained in a variety of colours, both the blotting and surface paper being varied in colour. Coloured blottings are made of the usual ingredients, with added colouring matter.

Duplicating, impression, and multi-copying are different names for the same papers. They are used for the various duplicating machines of the cyclostyle and mimeograph patterns, where a number of copies of

* 142 grm. per square metre.

written or typewritten matter is required quickly. A very thin ink is used, and it is necessary that it should be absorbed very speedily. These papers are practically unsized, contain a large proportion of esparto for the better qualities, and a certain proportion of mechanical wood in the cheaper sorts. A very large range of these papers is obtainable: laid or wove, white, cream, or tinted, with rough or moderately smooth finish. For copies produced by the same process, where a signature has to be appended, or when the form serves as a blank for written additions, paper which is half-sized is obtainable in similar weights, qualities, and tints.

Tissue papers are strong, thin papers, the best quality being made from hemp or rag fibre, well beaten, with no loading or sizing, made in blue or cream, usually double crown in size; other qualities are made from mixtures of rag, chemical wood, and straw, in various proportions and in various weights. Tissues serve a large number of purposes, as wrappings for high-class goods, therefore they must be strong and free from chemicals, for fly-leaves for the protection of engravings and prints, and also for the basis of carbon papers which are used for obtaining a simultaneous copy of written or typewritten documents, and some of the finest tissue papers are employed as cigarette papers.

Copying papers are similar in all respects to tissues, but some varieties have a small amount of mineral matter added to increase their efficiency. Made in cream wove, blue wove, and buff, put up in reams of 500 sheets, copying papers are for press copying correspondence which has been made in copyable ink, or typed

with special copyable typewriter ribbons. The leaf of the copying book is damped, the excess of moisture removed by an absorbent sheet, the document inserted, the book closed, and pressed in the copying press. By this means copies of correspondence are preserved for reference. Copying paper is also made up in rolls for copying machines which carry out the damping and copying automatically.

Gummed papers are made in a variety of qualities, colours, and substances. To obtain a satisfactory gummed paper three things have to be studied: body paper, adhesive, and thickness of coating. The inherent fault of gummed papers is the tendency to curl, but the extensive manufacture of non-curling gummed papers has done much to remove this bugbear. By adopting a paper which is affected but little by atmospheric changes something is accomplished towards minimising of curling, and by an ingenious breaking of the gummed surface non-curling is secured. When the coating is dry, the paper is drawn over a steel edge to break the homogeneous film of gum into innumerable fragments. In absorbing or parting with moisture (the cause of curling) the small particles can only act as individuals instead of combining and curling. Any kind of paper can be gummed, but the thinner the paper the more effective its adhesion when used as a label. When a label, slip, or any printed matter has to cover other printed matter, the paper must be opaque enough to prevent the matter beneath from showing through, and to ensure that opacity it may be necessary to use a thicker paper.

Gummed papers range from the thinnest transparent

parchment, through ordinary printings, to thick enamelled papers, and the gumming is varied to meet all requirements.

CARDS AND CARDBOARDS

Pulp boards are frequently looked upon as soft and flexible, and many may be so described, but for card index work a stiff snappy card, thin in substance, is required, and as paste boards and other cards made up of layers tend to split when subjected to much use, pulp boards are essential for that class of work. The boards which most closely resemble ivory boards in appearance will be found the most suitable for system use. A smooth writing surface, free from spots and other imperfections, is required, but the cards should be easy to rule and print. It is impossible to manipulate successfully cockled or wavy boards in ruling, printing, or cutting, so time will be saved if the selection of boards for index cards is made from the kinds which can be obtained perfectly flat. The softer kinds of pulp boards are excellent for a great deal of advertising matter, folders, post cards, and for jobs for which something stouter than the usual tinted papers is required. Where rigidity is demanded paste boards will be found of service. Some boards are made with grey middles and poor facings, but it is possible to obtain a good class of boards at a moderate price, and it is far more satisfactory to keep a stock of material of good appearance than to obtain the lowest quality possible. White cardboards should be rigid, of good colour, smooth, and should be so well sized as to be

suitable for post cards or similar work. Paste boards can be obtained in various substances, being described as three-sheet, four-sheet, etc., but there is no standard system in card thicknesses, as one maker's six-sheet will be the same as a four-sheet of another manufacturer. A very fair range of colours can be obtained in paste boards, but if a special colour is desired the manufacturer will require an order of sufficient size to justify a special making of facing paper.

Triplex boards are not made in the same variety of thickness or colours as paste boards. It is not possible to build up the substance in triplex and to dry the web successfully in the thickness of the heavier paste boards, but it is possible to procure very good triplex boards with most of the attributes specified for paste boards.

Boards may be coated in the same way as paper, provided the boards are not too thick. The thicker qualities are either coated on a modified machine, the looping being impossible, or coating by hand is resorted to. The boards are obtainable as one or two sided, with different degrees of surface and with different coloured coatings.

Coated boards are sometimes made by pasting coated papers to ordinary middles and finishing by plate rolling.

Thin box boards for use as cartons for small goods, such as cigarette packets, are coated with a coloured coating in the manner already described.

Coloured cloth-lined cards are first manufactured as paste boards, and are afterwards coated on the cloth side with the coloured coating, two applications being necessary in many cases to obtain the desired thickness

and surface. Plate-glazing is the means of imparting the ordinary surface to this class of cards.

The better qualities of cardboards will be found suitable for most classes of printing, even for half-tone work, but if three-colour blocks are to be printed, coated boards are necessary. Chromo boards, one or two sided, are obtainable from three to twelve sheet in substance, and on these any class of work will stand well. Owing to the burnished surface of these boards show cards keep clean for a much longer period than when ordinary cardboards are used, and frequently varnishing can be dispensed with if enamelled boards are not exposed to weather. Coated boards must be handled with care at all times, as the surface is sensitive to grease and moisture, notwithstanding its dustproof tendency.

Wholesale stationers keep a large and varied stock of cut cards, plain, round cornered, gilt edged, embossed, plate sunk, with fancy borders and fancy surfaces. A list of stock sizes will be found on p. 152, but this list does not refer to every variety of card. Some kinds, such as ivory cards, are stocked in all the regular visiting and business card sizes and multiples of the same, and others in the usual ticket and correspondence card sizes. Reference to the stock book of any maker will serve as a guide in ordering for stock or for special purposes. Post cards, plain and with printed fronts, are procurable in a variety of qualities, and often prove very useful to small printers.

The standard sizes for boards of various kinds are: Royal, 25 in. × 20 in.; Postal, 28½ in. × 22½ in.; Imperial, 30 in. × 22 in.; Large Imperial, 32 in. × 22 in.; Index, 30½ in. × 25½ in.

ALPHABETICAL LIST

Abrasive Paper.—Strong wrapping papers covered with abrasive powders of varying degrees of fineness, *e.g.*, sand, emery, and garnet.

Absorbent Papers.—Blotting papers, including photographic blottings, drying royals, duplicating papers, and cellulose wadding comprise this class of papers.

Account Book Papers.—Strong, even, well-made papers, hard tub-sized, with good writing surface, usually azure laid. Cheap varieties of account book papers are engine-sized, and the strength is not sufficient to bear the handling to which account books generally are subjected.

Air-mail Papers.—Thin, opaque writing papers, from 10 grm. per square metre (equal 5 lb. large post, 1,000 sheets), suitable for correspondence to be carried at air-mail rates. Some fourteen pieces, 10 in. × 8 in. (20 grm. M^2), may be included in an envelope within the ½ oz., which is the postal unit.

Ammunition Paper.—Carefully made papers of the air-dried wrapping variety for the manufacture of sporting cartridges.

Angle Papers.—Envelope papers cut at an angle in order to economise in cutting the envelope blanks. The angle may be varied to suit customers' requirements.

Anti-acid Manillas.—*See* Cable and Insulating Papers.

Art Paper is coated paper specially prepared for illustrated work; usually manufactured as detailed on pp. 45-46.

Backing Papers.—For stereotyping purposes. Brown papers which paste down easily and strengthen the flong.

Bag Papers.—Papers of medium substance for bags, unglazed, M. G., or glazed.

Banks.—Thin tough papers, glazed or unglazed, for use where strong papers of little weight are required. Usual sizes and weights, 45 grm. per square metre —foolscap, 15 lb.; large post, 23 lb.; medium, 27 lb., 1,000 sheets.

Bank-note Papers.—Hand-made papers for which new cuttings are used; as the notes have to withstand considerable handling, the paper is specially strong and tough. Watermarks of special design are employed.

Bible Papers.—Thin printing papers of good quality, opaque, and strong. Used for Bibles and other books where a large number of pages is required to occupy a small bulk. (*See* p. 41.)

Bill Papers.—Hand or machine made, all-rag papers, tub-sized, air-dried. Being used for documents such as promissory notes, bills of exchange, etc., the paper must be very durable.

Biscuit Caps.—Thin white M. G. papers, employed for making bags for confectionery and similar trades, in various sizes.

Blotting Papers are free from loading and sizing, are made from cotton rags, and frequently old soft muslins are thus employed. Cotton linters are used for cheap "rag" blottings. Esparto blottings, which generally contain added mineral matter, are less efficient than those made of rag fibres. Made in white, pink, buff, green, blue, and silurian, the usual size

is demy. Blottings for interleaving diaries and similar works are sometimes made of a mixture of rag and wood pulps, or even entirely of wood pulp, in much lighter weights, and in various sizes. Enamelled blottings are made by pasting enamelled papers to blottings of the usual substance.

Bond Papers are similar in character to banks, but are heavier in weight. The term is often applied to engine-sized writings of medium substance, but strength is essential in all papers included in this class.

Bowl Papers, unsized, bleached or unbleached, are used for the rolls in calendering machines, where there are alternate rolls of compressed paper and chilled iron.

Box Boards, in various qualities, from the common grey board to the tough glazed board, made from wood pulps and waste papers. Used by box makers, cut and creased by machinery, folded and fastened by glue or metal fastenings. Boxes for all trades are thus made, some being quite plain, others covered with coloured or fancy papers.

Bright Enamel Papers. — Enamelled papers, coated on one side only, finished with a high polish produced by calendering and brushing. Used for labels.

Bristol Boards.—Fine boards for black and white drawings. Various boards are called "Bristol," but the name rightly applies to those boards made of fine rag paper throughout, hot pressing being the method employed for obtaining the high surface. They are manufactured with the utmost care, free from all defects. Stock sizes—foolscap, demy, medium, royal, and imperial, and as papers of these sizes are pasted

and the finished boards trimmed all round, the boards are slightly smaller than the sizes of the papers.

Browns.—Brown wrapping papers are made of various materials and in many qualities and substances. Rope browns, air-dried, cylinder-dried are three kinds; "rope" being properly made from old ropes, but some papers sold under the name have wood pulps in their composition.

Butter Papers.—These are greaseproof papers used for wrapping butter and similar articles. Vegetable parchment papers are used, imitation parchments, and papers treated with a solution of albumen and salt, glazed or unglazed.

Cable Papers.—Also known as insulating papers, which better describes their purpose. These papers are made from various materials, such as manilla, jute, and sometimes wood pulp, usually unsized. Strength is essential, as they are cut to narrow widths, from one-sixth of an inch upwards, and wound round the individual wires which go to make up cables.

Calender Roll.—*See* Bowl Papers.

Caps.—Thin wrappings, used in a variety of trades, fall under this general description.

Carbolic Paper.—Strong packing paper impregnated with carbolic acid, used for packing goods liable to attack by insects or fungi. Carbolic acid being a powerful germicide, and poisonous to insects, acts as protection.

Carbon Paper.—Consists of a base of white or coloured tissue or printing paper with a coating of colour, ground in an oily or waxy medium, applied to one or both sides of the sheet. The pigment for the black, mauve, and blue carbons is largely composed

of lampblack, but other colouring materials are used. The paper is unrolled from the web, the colour applied to the surface, and brushes rub the coating into the paper. Passing over heated and cooled cylinders the paper receives its finish, and is reeled and allowed to mature. Afterwards the paper is cut to special or standard sizes (foolscap folio and large post quarto). Carbon papers for special purposes include two-sided, greaseless, typewriting, copyable, hectograph, and lithographic transfer.

Cards.—Paste boards, ivory boards, and pulp boards are cut into cards and put up in packets of 52 and 1,040. Retree cards have the wrappers inside out.

Carpet Felt Papers.—Thick, loosely felted papers, having very little strength. Made of waste papers, grey in colour, used for placing under carpets to prevent marking by floor boards, to give a better feel to the floor covering, and, when impregnated with certain ingredients, to prevent moth infesting the carpet. Made in widths of 54 and 60 in. and sold in rolls of 12 and 25 yds.

Carriage Panels.—A special variety of compressed mill boards, afterwards thoroughly waterproofed and used for roofing railway and other carriages.

Cartridges.—Strong papers, the best qualities are tub-sized. Originally made for cartridge manufacture, but now used for cover papers, as cheap drawings, and for a variety of purposes. *See* Offset Papers.

Casings.—Comparatively thin brown papers used for lining cases, crates, etc.

Cellophane.—*See* Transparent Cellulose Wrapping, p. 85.

Cellulose Wadding is made on the Fourdrinier

wire, the drying section being a modification of the single-cylinder (Yankee) machine. The film of paper is not glazed, but is removed from the large drying cylinder by a doctor blade. Assembling in a number of layers, slitting and cutting are the operations necessary to produce the wadding.

Chart Papers.—Largely used by lithographers for map and chart printing. Machine-made, the best qualities are all-rag, tub-sized, with smooth surface. Must be strong, pliable, tough, resistant to wear, and possessing a good printing surface. The manufacture is arranged so as to avoid changes in dimensions during printing operations and afterwards.

Cheque Papers.—Papers with special characteristics, either of strength or absorbency. Special watermarks may be employed, or protection from fraud is obtained by special printing. Other cheque papers contain chemical compounds which render alteration or erasure easy of detection. The means adopted for erasure cause chemical combinations which alter the colour of the ink, or develop chemical change which discolours the paper.

Chromo Papers.—Fine coated papers for colour lithography, having a thick coating on a good body paper, finished dull or with a good surface. The weights quoted are usually those of the uncoated paper.

Cigarette Papers.—Tissues of finest quality, wove or laid, thin, strong, free from loading and taste, and must burn easily. Ropes form the basis of the paper, fine beating being essential. Some papers have chemical additions to the pulp in order to ensure even combustion. Lettering or design may be impressed by dandy roll or specially engraved roll.

Cloth-lined Paper.—Cotton cloth, equivalent to scrim or common muslins, according to quality, having paper facing. Cloth-centred paper has thin paper pasted on each side, while cloth-backed papers are of better quality, with a fair cloth on the back. Useful where much handling is required. Cloth-lined cards (sometimes described as linen-lined) are thicker in substance than the papers. Surface enamelled cloth-lined cards are first made as cloth-backed cards and then enamelled with the coloured coating and plate glazed.

Cobbs.—Properly "Cobb's Papers," originating in a demand by Cobb for special end papers for book-binding. They are usually thin papers of good quality, dull in colour.

Coils.—Used for various purposes, such as telegraph, time recording machines, cash registers, calculating machines, music rolls for piano players, wiping the die in relief stamping, and for printing small forms on the reel. Papers are slit from the full reel, and re-wound on centres suitable for the machine or other spindles.

Collar Papers.—Papers for making paper collars and similar articles; made of wood pulp with a woven cotton or linen fabric rolled down to the paper, the surface filled with mineral and the whole highly rolled, or may be a coated board embossed to simulate a fabric collar.

Copying Papers.—Thin glazed or unglazed papers of the same character and composition as tissues, but sometimes having a small amount of mineral matter added to ensure perfect copying. These papers are used for taking press copies of correspondence, the

original being written (or typewritten) with copyable ink. The copying paper is damped, the superfluous moisture removed with a sheet of drying royal (*q.v.*), an oiled sheet placed at the back of the copying page, and the whole placed in the copying press and given a good squeeze. One or more perfect copies of the correspondence can be obtained by this method. As copying books are made with 500 or 1,000 leaves, the reams are made up of 500 sheets. Rotary copying machines employ copying paper in rolls, sometimes perforated at regular intervals, a damping roller preparing the paper; the copy is taken by rotary pressure. Everdamp copying paper eliminates the damping roller from this class of machine.

Cork Paper.—For packing bottles coarse wrapping paper is covered with adhesive, and on this powdered cork is sprinkled, making an elastic packing material. For cigarette tips a veneer paper of cork is pasted to tissue and cut to widths suitable for the well-known cork tips.

Corrugated Paper serves as protective packing for many classes of goods. Corrugation is effected by embossing paper of medium substance, or a web of paper may be corrugated by machine and glued or pasted to a flat web of similar paper. Obtainable in sheets or rolls.

Cover Papers.—The term is applied to a large class of fancy papers, made in many shades, substances, and sizes, suitable for the covers of pamphlets, booklets, price lists, for box covering, and the neutral shades for photographic albums and mounts. The qualities vary with the prices, the sizes following those most in demand, viz., medium (for demy), royal, etc.

Crayon Papers.—Drawing papers specially prepared for crayon work, with a rough surface, or finished smooth on one side. Hand-made or machine-made white or tinted papers are obtainable.

Crêpe Papers.—Tissues in tints and deep colours, crinkled by passing through rollers bearing the pattern, or by the use of a "doctor" while the web is still wet. The paper is much reduced in length, often to less than half the original length. Made up in rolls of 20 in. wide, 2½ yds. long. Used for many fancy purposes, candle and lamp shades, artificial flowers, etc.

Cutlery Papers.—Thin brown papers, glazed on one or both sides, manufactured with special care to avoid acidity, so that they are sometimes finished with *slight alkalinity in order that cutlery and similar articles* wrapped in the paper shall not be liable to attack from acid residues in the paper.

Detail Papers are unprepared tracing papers used for tracing details of drawings, etc. Translucency is obtained by prolonged beating, and the finished papers may be glazed or unglazed.

Drapers' Caps.—Very thin brown papers, glazed on one side (M. G.), made of wood pulp, used for wrapping small articles in many trades besides that of drapers; usual size, double crown.

Drawing Papers are made of the best and strongest rag fibres, free from impurities of all kinds. The highest classes of drawing papers are hand-made from unbleached fibre, tub-sized, with special treatment to avoid deterioration of the sizing, air-dried, and finished with various surfaces to suit different purposes. Machine-made drawing papers are made of the same materials with similar treatment, but papers of very

fair quality, made entirely of chemical wood and engine-sized, are on the market. Cartridge papers are frequently used as substitutes for ordinary machine-made drawing papers. The usual sizes are royal, imperial, double elephant, and antiquarian.

Drying Royal.—Strong, unsized papers, royal in size, used in copying books to absorb the excess of moisture after the copying paper has been wetted. Blotting paper is not sufficiently strong to stand the handling to which the drying royal is subjected. Hand-made papers of this class are all rag, but other fibres are used for some of those made on the machine.

Duplex Papers may be made of two layers of differently coloured papers brought together in the wet state and rolled together, or may be coated with different colours, after the paper is made, as duplex art papers, or imitation art coloured on reverse sides with different dyes when receiving water finish. *See* Twin-wire Papers.

Duplicating Papers.—Unsized or half-sized papers used for taking copies on cyclostyle, mimeograph, and similar duplicating machines. Best qualities are composed largely of esparto, but the common varieties contain mechanical wood. Usual sizes: double foolscap and large post.

Embossed Papers.—Papers of various qualities and colours are run through rollers engraved with patterns, by which means the papers are permanently embossed. Hard cover papers retain the patterns better than softer papers, but many kinds, repp, linen, crash, crocodile, and other leather patterns are made upon soft papers. Embossed papers find favour as cover papers and box-covering papers.

Enamelled Papers are body papers with a mineral coating on one side, white or coloured, the surface being highly polished. Used for labels, box coverings, and outside wrappers of various kinds, printed in one or more colours.

Engine-sized Papers.—The majority of papers are sized with rosin, which is added to the pulp in the beating engine, hence the term "engine-sized" (E. S.). The attempts to size with animal size in the engine are not completely successful, as a large part of the gelatine, being in solution, goes away with the water. Most machine-made papers which are tub-sized are to some extent engine-sized.

Envelope Papers.—All kinds of paper may be used for envelope making, but papers highly glazed on one side are usually meant. The highly glazed surface is more suited for writing, while the rougher side takes the gum for the flap better than a burnished surface. Envelope papers are usually cut at an angle to prevent waste when cutting out blanks for envelopes. Demonstration of the waste involved by the use of square paper can be made by opening an ordinary envelope, and marking it out on a sheet of stock paper.

Featherweight Paper.—A term applied to bulky book papers much in favour for current fiction. The fibre is esparto, beaten quickly, no loading, but little sizing, very little pressure while passing through the machine. The fibre being loose occupies a large space, and the paper is very light for its bulk, hence the term.

Filter Papers are used in chemical laboratories to separate substances in suspension from liquids. It is essential that the papers be entirely free from

chemicals, and allow liquids to pass freely while retaining suspended matter. All-rag fibre is used, but grey filter papers may contain a proportion of wool fibre. Filter papers may be subjected to special treatment to remove all matter that is likely to confuse chemical analyses. Usual size, 24 in. × 24 in., and circles of various diameters.

Foil Papers.—Metals reduced to fine powder are dusted upon the paper which has received a coating of adhesive, and when all is dry the surface is highly burnished. Leaves or webs of metal may be used as coatings. Embossed foil papers are passed through special rolls. Used for wrapping and decorative purposes.

Fruit Paper.—Thin papers, similar to tissues in texture, but much lower in quality, used for wrapping fruits—apples, oranges, etc., before packing. It is found that this isolation justifies the trouble and expense, an increased percentage of sound fruit reaching the market. Some wrappers are printed with the merchant's name and address.

Glassine (*Glacine*).—Glazed transparent papers, made in the same manner as greaseproof papers and then highly glazed; usually greaseproof. Made in white and colours; used for packing, for protective purposes, as windows in envelopes, and, when shredded to shavings, as packing for chocolates and other commodities.

Glazed Boards.—Mill boards which are given a very high surface by repeated rolling. *See* Press Boards.

Glazed Imitation Parchment.—Made from strong sulphite wood pulp, engine-sized, and highly glazed.

The paper usually has a wild look through. Employed as a fine packing paper, and, in thinner substances, may be printed and waxed for sweetmeat wrapping.

Grass-bleached Tissues.—This term is applied to special tissues to describe papers quite free from chemicals. The ideal method of bleaching linen is by exposing on grass, and though these tissues are not treated in that manner, the ideal papers which will not tarnish silver or other bright metal goods are so described. Used for wrapping silver goods, and for protecting metal decorations and buttons on uniforms.

Greaseproof Papers.—Used for packing butter, lard, and other provisions; prepared as such in the pulp by prolonged beating ("wet" pulp being the result of long beating), producing paper which is close, translucent, and is greaseproof. Other papers are rendered greaseproof by coating. (Vegetable parchment papers are used for similar purposes.)

Grocery Papers.—The well-known blue sugar paper and purple sugar bags are examples of this class of paper. They are made of low-grade pulps, with which are mixed waste papers, a moderate amount of loading, and aniline colours. The squares are cut at the mill and bags too are often produced at the paper mill.

Hosiery Papers.—These are special heavy white wrapping papers, prepared to stand a good amount of handling, used as wrappers for packets of hosiery stock, and for similar purposes.

Illustrated Letter Paper.—Bond paper, coated one side, and thus may be used as an illustrated writing paper.

Imitation Art Paper.—To meet the demand for

a cheaper paper than art paper, with some of the characteristics of the latter, such as opacity, absorbency, and a surface suitable for printing half-tones, imitation art papers have been introduced. They contain a large proportion of loading, and receive a good surface by water finish or super-calender.

Impression Papers.—Another term for duplicating papers. *See* Duplicating Papers.

Index Boards.—Pulp boards made of strong stuff, even, hard-sized, well-rolled, giving a good writing surface. It is important for card-index systems to employ a card which is made in one thickness only; paste boards bend and split at the corners if frequently handled. The uncut boards should be perfectly flat in order that ruling, printing, and cutting may be executed with accuracy. Guillotine cutting is not so satisfactory as cutting singly with a hand cutter or rotary cutting on a card-cutting machine. The usual sizes of index boards are 20½ in. × 25½ in. and 25½ in. × 30½ in., cutting to 3 in. × 5 in., 4 in. × 6 in., and 5 in. × 8 in.

India Proof Paper.—Thin paper made from the inner fibres of bamboo stems. Extremely soft and absorbent, it is therefore eminently suitable for taking full-bodied impressions in plate printing.

Insulating Papers.—For insulating wires for electric cables. *See* Anti-acid Manillas *and* Cable Papers.

Ivory Boards.—Hard, white, transparent boards, made from well-beaten stuff, the substance being obtained by pasting two or more webs of paper together. Ivories are obtainable in three or four substances, white or cream, and are used for high-class work, such

as visiting, business, and menu cards. Stocked in royal boards, and also in various cut sizes.

Japanese Copying.—Specially thin and strong papers made in Japan from long fibres, used for copying books. Japanese papers are hand-made, the fibres pulped by hand, the sheets made on moulds of bamboo or hair. The length of fibre, precluding machine making, makes a paper of exceptional wearing qualities, the fibres pulling apart and not tearing.

Japanese Vellum.—Thick papers made of Japanese fibres, very tough and durable, almost as difficult to tear as vellum. Finished with a good surface, suitable for certificates and various jobs where very tough and durable material is required.

Kraft Papers.—"Kraft" means strength, and this is the characteristic of these papers. Unbleached sulphate wood pulp is the material used, prepared by prolonged boiling under comparatively low pressure, the fibres receive less drastic chemical treatment than is usual in the preparation of wood pulp. Reduction to fibrous state may be accomplished by the edge-runner drawing the fibres out, thus retaining the length and strength, or beating may be carried out as for other papers. Kraft papers are usually light brown in colour, strong and flexible, and are used for wrappings where these qualities are required. They are made unglazed, machine-glazed or glazed, sometimes ribbed.

Leather Boards.—Boards made of specially prepared mechanical wood pulp, being the colour of leather. Used for box making. Standard size, 24 in. × 38 in., and substance from 200 to the cwt.

Leatherette.—Papers used for box covering and for covers of cheap note-books. Common papers

made to colour of the leather of which they are imitations, either as coloured body papers, or with coloured surface, and then embossed with leather grain.

Ledger Papers.—Strong, well-made writing papers, used for ledgers, therefore manufactured to withstand considerable handling. The best qualities are all-rag, tub-sized, air-dried, plate-glazed, quite opaque, with equal surface both sides.

Lined Brief.—Foolscap paper ruled with thirty-six lines across the width of the paper, and a vertical marginal line. Hand-made and high-class machine-made papers of this kind have the lines as watermark.

Linen-faced Papers receive their patterns in one of three ways: (1) by passing between embossed and engraved rollers, as described under embossed papers; (2) by interleaving with zinc plates upon which are glued sheets of linen and passing through the plate-rolling machine; (3) by passing the web of paper together with linen fabric through a pair of rolls, the pattern being impressed upon the paper. Many writings and cover papers are supplied with linen-faced finish.

Lithographic Papers.—Papers for lithographers' general use, with good super-calendered surface, the manufacture so arranged as to reduce the amount of stretch to a minimum. The best qualities are made of rag, the next quality of esparto. With the advent of the off-set lithographic press, all papers have become possible as lithographic papers, but the description applies only as above.

Loan Papers.—Superior wove papers, made of the strongest materials, tub-sized and finished with a good

writing surface. The materials and treatment are similar to those employed for bank papers, but the substances are heavier.

London Boards.—Originally boards formed by pasting sheets of best hand-made drawing paper. Thick paste boards are sometimes supplied as London boards.

Long Elephants do not concern the ordinary printer. They are used by paper stainers, that is, wall-paper printers. They form the ground papers for wall-papers, are frequently of the same materials as printing papers, but put up in rolls of 22½ in. in width, with a length of 12 yds.

Magazine Paper.—Soft printing paper with a good super-calendered surface giving equal printing surfaces for half-tone illustrations each side of the sheet. Imitation art papers also are used for illustrated magazines.

Manifold (Typewriting) Banks.—The thinnest substances of typewriting papers in lighter weights than are ordinarily used as banks are so described. The descriptions under Banks and Typewriting Papers are applicable to Manifold Banks.

Manifold Papers.—Papers used for taking copies at the time of making the original by writing or typewriting by means of carbon papers. In order to obtain a better impression of the original, the manifold paper, which is a tissue, may be impregnated with oil. To enable the paper to take ruling and printing, the paper is allowed to mature for some time to allow the oil to become distributed evenly throughout the paper.

Manilla Papers.—Strong, tough, flexible papers made from manilla hemp. Manilla does not bleach

easily, the so-called white manilla papers being always low in colour. These papers are used for manilla labels (parcel tags), cartons, folders in index systems, correspondence covers, index cards, and for work where strength and durability are essential. The term " manilla " is now applied to a class of paper rather than to the papers made entirely or principally of manilla fibre. Many such papers are composed of unbleached chemical wood pulp, a long-fibred tough paper resulting, which is suitable for most of the purposes for which manilla papers are generally employed. For envelopes, however, the genuine article is not easily replaced. Low-grade manillas may contain mechanical wood.

Map Papers are thin and tough, folding without cracking, usually slightly sized with animal sizing. Used for printing maps which are to be folded into small compass.

Marbled Papers are used for covers of various books, as wholly covering the book, or as sides in half and quarter binding, but the principal use is for end papers in account books. High-class marbled papers are made a sheet at a time in the following manner: a trough of gum is prepared, the colours for the pattern are sprinkled and dropped upon the surface, patterns are made by combing or some other means of regularising the design. The body paper is let down carefully to the gum, the colour adheres to the paper, and the sheets are hung to dry. Intricate machines are employed to make marbled papers, depositing the colours for transference to the paper. There are many patterns of marbling, the favourites being the Spanish, shell, and nonpareil designs, carried

out in reds, blues, and greens. Fancy marbled papers are sold, but binders are conservative in their tastes. Cheap marbled papers are produced by lithography.

Matrix Boards.—Boards made of medium quality materials, with a heavy mineral coating, serving as "dry flong" for the production of stereotype moulds.

Metallic Paper is a coated paper for special uses, such as note-books for indelible writing, in which case writing with a metal stylus or indelible pencil is easily made, but cannot be erased; for indicator diagrams for various instruments where a light touch only can be given, but the diagram is faithfully recorded. A good quality paper is coated with a mixture of glue and zinc oxide, usually applied by hand and finished in the same way as art papers. Cheaper metallic papers are coated with barium sulphate.

Middles.—The materials for middles (of paste boards) vary from waste paper to all-esparto fibre. Grey middles contain a large proportion of waste, mechanical wood, and added mineral matter, while white middles are usually free from mechanical wood and of very fair strength; made with machine finish, in order that the subsequent pasting of facing papers may be more thoroughly performed. In addition to their use for paste boards, middles are used for tramway and bus tickets, frequently being tinted in the pulp.

Mill Boards are made from various waste fibres and waste papers. Hand-made and the best machine-made boards are made from hemp and flax fibres, the commoner machine-made from waste papers with or without long-fibred material. The raw materials are reduced

to pulp (the stronger materials boiled and beaten), made into boards in hand moulds or on special board machines, pressed, dried, heavily rolled, trimmed to size. Used for binding, box making, portmanteaux, carriage panels, etc. *See* p. 155 for Sizes and Substances.

Mottled Papers.—Usually tinted papers with mottling of a darker colour. *See* Silurian.

Mould-made Papers occupy a position between hand and machine made papers, having most of the characteristics of hand-mades. The moulding is mechanical, but the other operations are carried out as for hand-made papers. Four deckled edges will be present.

Music Papers, used for printing sheet music, are thick printing papers with a moderate amount of sizing, and with machine finish, making an easy printing surface for music type, plates, or lithographic surfaces. Usual size: demy, 20½ in. × 14¾ in., 100 grm. per square metre.

Nature Browns.—Brown papers, unglazed or machine-glazed, made from natural brown wood pulp, unbleached, undyed.

News.—Common printing papers, containing 70 to 80 per cent. of mechanical wood and little or no sizing. Suitable for news and other work of an ephemeral nature. Supplied in reels or sheets. Standard substance, 52 grm. per square metre (29 lb. demy, 44.5 lb. double crown, 1,000 sheets).

Non-curling Gummed Paper.—Specially prepared gummed paper, the body paper being made as nearly free from stretch as possible, and the coating of gum, when dry, is broken into fine particles by drawing

the finished paper over a steel bar. This prevents the film of gum from acting as a single surface, and only when the particles again cohere is the non-curling property destroyed.

Oiled Paper.—*See* Manifold Paper *and* Stencil Paper.

Onion Skin.—A term applied to thin, hard, highly glazed translucent papers, because of their resemblance to the thin outer skin of the onion.

Pamphlet Papers.—Tinted papers of various substances, used for covers of pamphlets, and for a large variety of jobbing work where a paper of fair weight is required.

Parcel Tape Paper is supplied in various widths and qualities, from ordinary gummed paper to kraft brown with gummed back; used for fastening small parcels instead of string or wax. Supplied in coils for use with a special damping machine.

Parchment Papers.—Properly, parchmented papers, *i.e.*, the cellulose of which the paper is composed is altered in character to resemble parchment. A web of unsized paper is passed through a bath of strong sulphuric acid, which attacks and dissolves the cellulose, changing its fibrous form. Before the change is complete the paper is washed, the acid is neutralised, and the paper dried. The paper shrinks considerably, but is greaseproof and much stronger than before treatment. Vegetable parchment and pergamyn are alternative names for the same material. Used as an impervious packing paper for provisions, for tea packing, jam covers, etc.

Paste Boards.—Cardboards formed by pasting fine papers to middles which may be wood-free (white

middles) or grey middles made from waste papers. Distinct from triplex, ivory, and pulp boards.

Pastings.—Papers for pasting down; facings for paste boards; covering paper used by box makers, white or coloured.

Plate Papers.—Thick, soft printing papers, made of good material, soft-sized. The thicker kinds are made by bringing two or more webs together in the wet state and pressing them together, one side only being calendered. Used for taking impressions from engraved copper and steel plates, also for fine lithography.

Porcelain Paper.—Thick transparent paper of the nature of celluloid, made of well-beaten pulp. Used for Christmas cards and similar work.

Portmanteau Boards.—Tough boards used for the shapes or shells of portmanteaux and trunks, over which the leather or canvas cover is fixed. Manufactured in the same manner as mill boards, flax and hemp fibres being employed.

Poster Papers.—For printing posters in black by letterpress, machine-finished papers may be employed. Lithographers employ M. G. poster papers, usually made of bleached sulphite wood pulp.

Pottery Tissues.—Tissue papers specially prepared for printing transfers for pottery decoration. The printing is from copperplate, engraved rolls, or lithographic surface, and the pattern is transferred to the china or earthenware before final firing.

Pressings.—Thick coloured papers, single colour or duplex, made on the single-cylinder machine, therefore with M. G. surface. Used for packing, for the covers of exercise books, for box covering, etc.

Press Boards.—Thin, hard glazed boards, made of the best materials *See* Mill Boards. Heavily rolled and friction glazed. Used for pressing cloth; for pressing printed work, etc. Now used for insulating purposes; for filing systems, etc.

Printings.—A large class of papers, which are usually made with a fair surface, machine finish. Printings are moderately sized, so as to absorb ink readily, and only a small quantity of filling is added. The materials used include all the fibres which will bleach well; hand-made printings are tub-sized, machine-made are all engine-sized. Rag, rag and esparto, rag and chemical wood, chemical wood and esparto, chemical wood, chemical and mechanical wood papers are the varieties obtainable, white or toned. Super-calendered, imitation art, and art papers are included under this heading. Sizes, weights, and prices on pp. 150-51.

Profile Papers are specially ruled papers for the use of engineers and surveyors; ruled, or printed from engraved roll. The usual pattern has ¼-in. squares divided into five horizontal sections.

Programme Papers.—Soft papers, white or tinted, used for concert programmes, in order that there shall be no rustle when the pages are turned. The lighter weight of drying royal is sometimes used as a programme paper.

Pulp Boards are boards made on the Fourdrinier machine, usually of one layer of pulp only, well sized, well rolled, in various substances and qualities, and in a variety of useful tints. Used for all purposes for which cards are employed. *See* Twin-wire Papers.

Railway Buffs.—Cheap buff papers used for forms

and envelopes. There are several classes of buff wrapping papers employed for railway work.

Rice Paper.—The pith of the *Fatsia papyrifera* is cut into sheets in a manner similar to that used for cutting veneers, and the resulting material is used as a support for small paintings and for making artificial flowers. It is not properly described as paper.

Rocket Paper.—Thick coarse paper used for making cases for rockets and other fireworks. White, coloured, or fancy papers are pasted on the outside of the firework cases, and the touch paper fastened on last.

Royal Hands.—A term used for wrapping papers made to royal size (24 in. × 19 in.).

Safety Cheque Papers are specially prepared by printing, as a groundwork, a design in ink which is fugitive if treated with chemicals, or if erasure is attempted. Other safety papers are made by adding sensitive chemicals to the pulp, or by impregnating the finished paper. These additions act as indicators of any alteration or attempt to remove the original writing by means of ink eradicators.

Sampling Papers.—Coloured papers used for the display of textile and other samples, usually deep blue or deep yellow, in sheets or in rolls.

Sealings.—Thin, tough, unglazed, or M. G. papers used as parcel papers. Sealing wax adheres readily to the unglazed side. Made in various substances and colours.

Sectional Papers are papers with squares of definite measurement, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{10}$, $\frac{1}{12}$, $\frac{1}{16}$ in., or millimetre ruling. The larger squares are ruled, the smaller are printed from engraved rolls or from electrotypes of

engraved plates. Printed on drawing paper, also on thin paper for subsequent reproduction by contact with sensitised papers.

Sensitised Paper.—Various papers for photographic printing, the paper receiving treatment after making. The emulsions are made and applied to the surface of the papers, or the paper is passed through a solution of sensitive salts.

Shops.—White papers for packing, either glazed or unglazed; white grocery papers are shops.

Silurian.—Grey paper mottled with blue fibres. The pulps are coloured separately with fast dyes, and a small proportion of the darker fibres added to the grey pulp.

Skips.—Thin packing papers for lining skips or crates in which various goods are packed.

Small Hands.—Thin wrapping papers, usually made from low-grade material.

Squared Papers.—Ruled or printed squares of various sizes on drawing, cartridge, and tracing papers. *See* Sectional Paper.

Stencil Papers (waxed, etc.) are used in connection with cyclostyle, mimeograph, and similar machines. Thin, strong, unsized papers are coated with wax or other material, and a stencil is actually made by removing the coating in various ways. For stencils made by handwriting the coating is removed by writing with a stylus on a file plate or a metal plate covered with bolting silk, or a cyclostyle pen, having a wheel at its tip, is used, making a series of perforations through the coated paper. With the typewriter the coating is removed by a blow of the letter upon a tissue which is placed in front of the stencil paper. Wherever the

coating is perforated or removed ink can be forced through the stencil, and the prints, although not always showing the broken lines of stencil work, are actually produced by stencil process. Japanese tissue papers or papers with similar long fibres are usually employed as the basis of stencil papers.

Stencil Paper (oiled).—Thick strong paper used for cutting stencils for decorators. Manilla or other strong papers are impregnated with linseed oil, and sometimes varnished on one side.

Stereotyping Papers.—Tissues, grey blottings, and brown papers, as used in making stereo flong, are included in this category. It is possible to obtain flong papers made on the paper machine, the three papers being made separately and brought together before the couch rolls are reached. *See* Matrix Boards.

Straw Boards.—The cheapest boards obtainable for binding and mounting purposes, made from straw. Usual sizes, 30 in. × 25 in., 32 in. × 22 in., the boards being made up into bundles weighing 56 lb.; the weight of individual boards governing the number in a bundle, *e.g.*, 8 oz. board, 112 to bundle; 2½ lb., 22 in bundle, etc.

Sulphite Wrappings.—Wrapping papers made from sulphite wood pulp, bleached or unbleached, white or coloured, producing very strong papers.

Super-calendered Papers.—Term applied to printing papers which have received a high surface by passing between the rolls of the super-calender; but most writings, art, manilla, and coloured papers receive their finish in the same manner.

Surface-coloured Papers are frequently made

on thin papers in the manner described on pp. 45-46, and the finish may be unglazed or glazed. Used for labels, box covering, etc.

Tea Cartridges.—Generally made from chemical wood, but in some cases a mixture of rag and chemical wood is employed. Engine-sized, supplied in sheets or reels.

Ticket Boards.—Paste boards with good white or coloured facing papers, sometimes coated, white or coloured; used by ticket writers for window tickets.

Tips.—Binders' tips are very thin mill boards. Trunk makers' tips are thick, tough, brown papers.

Tissues.—Fine thin papers, made of strong materials such as rag and hemp fibres, beaten very finely. Other tissues are made of chemical wood and a proportion of straw pulp, and also with a large proportion of mechanical wood pulp in the form of Drapers' Caps, Nature Tissues, Bottle Wrappers, etc. Papers are unsized, used for wrapping and protective purposes.

Tobacco Papers.—Papers used for packing small quantities of the cheaper tobaccos; with good printing surface.

Toilet Papers.—Very thin papers put up in packets of cut pieces, or in rolls with or without perforation. The orthodox weight of a toilet roll is 12 oz.

Tracing Papers.—Thin papers specially treated with a mixture of certain gums and turpentine. Used for tracing maps, plans, drawings, etc. Other papers used for tracing approximate to imitation parchments. *See* Detail Papers.

Transfer Papers.—Specially coated papers for transferring designs to lithographic printing surfaces.

Opaque or transparent papers are used, according to the use of the paper whether it is merely as a transfer paper or also as a tracing paper. The coating mixture is such as will readily strip from the paper when put down on stone and the back is damped, all the ink of the transfer being left on the stone.

Transparent Cellulose Wrapping is a film of cellulose xanthate, acetate or nitrate, but is not paper and is not made by the papermaker. There are various proprietary names given to the material which is procurable as colourless or coloured sheets or rolls.

Triplex Boards are made on a multi-cylinder machine, three different layers being assembled in the wet state, and rolled, dried, and finished as a single web.

Tube Papers.—Soft unsized papers, made with a good percentage of rag, for making tubes or spools on which the yarn for spinning machines is wound. Heavy wrapping papers are also employed for this purpose.

Twin-wire Papers have been made for some considerable time, but it is only recently that the description has been used for sales purposes. Two webs are made on separate moulding units and united before or at the press rolls by pressure alone or with a small amount of adhesive in addition. Twin-wire practice has been extended to the manufacture of pulp boards and other materials. (*See* p. 21.)

Typewriting Papers.—Strong bank papers of good appearance, unglazed, used for correspondence and other typewritten matter. The extra superfine qualities are all-rag, tub-sized; some of the lower grades, chemical wood, engine-sized.

Vegetable Parchment.—Another name for parchmentised paper. *See* Parchment Paper.

Vellum Papers.—(1) Name applied to writing papers with a good writing surface, not so smooth as super-calendered papers, but nearer to the surface of a well-finished vellum. Usually vellum woves, although laid papers with vellum finish are supplied. (2) Thick, strong, fine papers, used for engravings. *See* Japanese Vellum.

Vulcanised Fibre.—Paper is treated with zinc chloride, and the semi-fibrous sheets are pressed together to form boards of great density and strength. The boards are thoroughly washed to remove all the unwanted by-products.

Whatman Boards are made by pasting sheets of " Whatman " drawing paper together until the desired thickness of board is attained. Boards only faced with " Whatman " paper are also supplied under this name.

Wheatstone Paper.—Blue tinted paper cut to narrow width for use in the tape machine, the telegraphic messages being recorded on the paper strip.

Waterproof Papers for packing purposes are made by coating strong wrappings with tar or bitumen, and rolling scrim on to the surface to prevent the coating coming in contact with the contents of the package. A coating between two sheets of thin wrapping paper is another method of waterproofing. Used for protecting goods from the influence of moisture. Roofing paper is a variety of waterproof paper prepared by impregnating felt papers with tar.

Waxed Paper.—Paper passed through a bath of melted paraffin wax which makes it perfectly

impervious to moisture. Waxed tissues and imitation parchment papers are used for sweetmeat wrapping. Sulphite wrappings are waxed for bread wrappers.

Willesden Paper.—Strong paper rendered impervious to moisture by immersion in a bath of cuprammonium hydroxide. The surface of the paper is partially dissolved, and the paper is washed, rolled, and dried. If a thick sheet is desired, thinner sheets are brought together while wet and consolidated by rolling.

Wiping-off Papers.—Papers used for relief stamping machines; usual substance demy 40 lb. to 60 lb.; in widths from 2 in. upwards. M. G. kraft and soft unsized papers may be employed according to the type of machine.

Wood-pulp Boards.—Boards made from mechanical wood pulp or chemical wood pulp; used for boxmaking, mounting, etc. In substance from 30 to 300 to the hundredweight, on the basis of 22 in. × 32 in.

Wrapping Papers are described under the heads of Bag, Biscuit Caps, Browns, Caps, Carbolic, Casings, Cork, Corrugated, Cutlery, Drapers, Fruit, Glassine, Glazed Imitation Parchment, Greaseproof, Grocery, Hosiery, Kraft, Nature, Parchment, Rocket, Royal Hands, Sealings, Shops, Skips, Small Hands, Sulphite Wrappings, Tea Cartridges, Tobacco Papers. Sizes, weights, and prices on p. 154.

Writings.—Hard-sized papers of all kinds are suitable for writing, but an even paper of good surface is essential. *See under* Account Book, Air-mail, Banknote, Banks, Bill, Bond, Cheque, Ledger, Lined Brief, Loan, Safety Cheque, Silurian, Typewriting, Vellum Papers. Sizes, weights, and prices on pp. 148-49.

SECTION III

THE USE OF PAPER

PAPER is so important a factor in any printed work that it is essential that users should make suitable selection from the varieties available. Matching samples of paper is not simple, and sound judgment of the comparative values of different papers can only be attained by long experience. A few guiding principles, without making a royal road, may render the journey somewhat less laborious.

The descriptions of varieties of papers in the foregoing pages — writings, printings, coated, and other papers—are accompanied by indications of their general purposes, which should guard the inexperienced from making serious blunders. Common sense will prevent the mistake which is still perpetrated of printing a half-tone block on a laid paper, or a paper with a heavy watermark. The laid lines and the watermark show up through the half-tone impression and spoil the picture. Half-tone work demands a perfectly smooth paper, coated, or a good super-calendered paper being suitable. Offset lithography can be executed on laid or watermarked papers without the defects which follow letterpress printing on such papers.

Very few papers are identical in finish on both sides of the sheet, and it should be the first thing

taught to the apprentice that all one-sided work should be printed on the right side of the paper. A matter which is seldom referred to is the position of the watermark. When cutting paper it should not be turned so that in a ream one-half has the watermark reading correctly while on the other half it is upside down. If the paper is ruled or printed in the sheet, the pens and type or transfers should be arranged to keep the watermark the right way. In the case of folded and stitched work this is not possible without special watermarking, but for all stationery these precautions should be taken.

When judging paper or cards it must always be remembered that a sheet may compare very badly with a small piece, therefore when making comparisons the sizes of the samples of paper or card should be cut to the same size. Only by adopting this practice can weight, colour, and texture be judged accurately.

Choosing a paper suitable for the work in hand is simplified when one knows what is used for similar work. For ledgers, account books, and all work of that character a strong, tough, well-finished paper capable of taking writing ink easily and able to bear ink after erasure should be used. An opaque all-rag, azure laid, tub-sized paper of moderate weight, 132 grm. per square metre, is the most suitable paper. For looseleaf ledgers a thinner, tougher paper is desirable, as the leaves must lie closely and withstand the strain of frequent handling. For cheap account-book work engine-sized papers are obtainable, very fair in appearance but not possessing all the qualities of the better paper specified, or the extra cost of the latter could not be justified.

The ideal paper for printed books is an all-rag paper, moderately sized, with antique or rough finish, excellent in handling and appearance, but the price precludes its use for any but the most luxurious editions. For ordinary bookwork, white paper with dull or machine finish, quite opaque, substance equal to 100 grm. per square metre, provides a serviceable paper where no illustrations, or line blocks only, appear. If half-tone illustrations are included, a super-calendered paper, slightly toned, is very suitable. When half-tones of very fine grain are used, it may be necessary to print on art paper throughout, or to have the illustrations printed on art paper and the body of the work on a printing paper of exactly the same shade as the coated paper. Mixture of shades in books should be avoided as far as possible. The practice of printing sections of magazines on different papers is growing, but is to be deprecated.

Half-tone illustrations are employed for all classes of letterpress printing, and the ordinary range of half-tone screens is from 55 to 150 lines to the inch. For M.F. printing, news, and poster work, 65 to 85 lines will prove serviceable. For super-calendered news and papers of moderate surface, 80 to 90 lines to the inch should be employed. For magazine work and commercial work on super-calendered papers a screen of 100 to 120 lines gives good results. Illustrations to be printed on coated papers should be made with a screen from 133 to 150 lines to the inch. While it is possible to obtain half-tones of finer grain, only in exceptional cases are such called for, and the highest grades of coated (art) papers with high finish should be used for printing.

Photogravure printing is executed upon many kinds of paper, from super-calendered news to specially made rag papers. Most photogravure work is produced on fast-running rotary machines, and the most suitable papers are those with smooth surfaces, not highly glazed, not heavily loaded, and not hard-sized, but capable of being run at high speeds. Quick drying is essential. Papers are available, made of esparto, which satisfy all the requirements of rapid printing of high quality.

It is sometimes claimed for new processes that "any" paper may be used. That may be true. But it must be conceded that every printing process is most effective when a paper is selected for the purpose of securing a desired effect, whether it be contrasts, depth of colour, or delicacy of detail.

For works which have to make bulky volumes for a comparatively few pages, featherweight papers are employed. These in 100 grm. per square metre will usually be chosen, wove or laid, as fancy dictates. Some wholesale stationers indicate on the samples the thickness or bulk of a volume of a definite number of pages, this information serving as a guide in selecting paper to produce the thickness required in a volume. When a series of books is issued it is sometimes desired to have all the volumes of equal bulk. This is attained by adopting papers of different thicknesses; thus a book of 500 pages is printed on a paper about half the thickness of that used for a volume of 256 pages. The range of substances in which papers are supplied renders this arrangement comparatively easy.

The large variety of fancy papers for jobbing work calls for little comment. Avoid hard papers for

programmes unless there is plenty of time for the ink to dry, or gloves may bear the printer's imprint. For outdoor functions coloured papers, if employed for programmes or similar jobs, should be coloured with dyes which are unaffected by showers. Art paper, too, is unsuitable for outdoor exposure in our changeable climate, and is to be discouraged for sport programme work. Coloured poster papers must be unaffected by rain and reasonably fast to light. Many coloured papers render printed matter exceedingly difficult to read by artificial light.

The incongruity of a common cover paper to a booklet printed on a good printing paper, or vice versa, is to be avoided. Select papers for the inside and cover, bearing both in mind, and if expense is to be considered a compromise in quality may be effected.

It is not always easy to persuade the consumer to select the very best paper for office stationery, but the choice should be made with a view to create a good impression. Remember always, too, that printing demands good paper to produce the most satisfactory effect.

For lithography the work in hand frequently dictates the quality of paper to be used. Offset printing, certainly, has enabled the lithographer to print on papers unsuitable for direct litho. printing, but in all work the right paper produces the best result. Fluffy papers, such as featherweights, however, are impossible for lithography. Loose of texture, with a tendency to shed fibre, the paper clogs the printing surface, and in such circumstances the best work is unattainable. Charts and maps are printed on strong,

durable papers, and the manufacturers' chart papers will be found to conform to the description given.

Colour work requires a paper which will give full effect to the colours superimposed upon its surface, white paper being most suitable for the purpose, the description of paper employed being governed by the destination of the printed work. Chromo paper, litho. paper, M. G. poster paper, will be used according to the method of exhibition of the work, as calendars, labels, book illustrations, or posters. Work which is to be varnished may be printed on litho. paper, which is sized and varnished after printing, or a varnishable paper, one that is hard-sized and finished in the manufacture, may be used, varnish being applied without previous sizing, as soon as the ink is dry. A thick litho. paper is seldom as strong as a thinner one, and with the greater thickness there is more liability for the surface to pluck or lift.

The thinnest and commonest papers should not be chosen for set-off or interleaving sheets. Although many papers, when printed, absorb the ink and hasten the drying, it must be remembered that printer's ink, like paint, dries by oxidation, and the more freely air can reach the film of ink the quicker and more thorough will be the drying. A strong rough-surfaced paper is most suitable for interleaving, as it will not stick to the printed matter, it allows air to penetrate between the sheets, thus facilitating drying, and the paper is suitable for repeated use for the same purpose. For interleaving colour work in which bronze is used at all, a paper of fair quality must be used, for common papers may contain chemical residues which will affect the brightness of the bronzed work. Paper

of about 90 grm. per square metre will serve admirably, and may be used repeatedly.

Proofs should be printed upon the paper which is to be used for the job, if that is possible. Galley proofs require a paper which is moderately sized, not too soft, or corrections made in ink may be undecipherable from the spreading of the ink.

It is not difficult to distinguish between the right and wrong sides of most papers, and little excuse can be made for the printer who uses the wrong side. Twin-wire papers, of course, have practically identical surfaces. Flat papers are usually packed with the right side uppermost; if the paper is folded, the right side is outwards. There is a slight diversity of practice among paper-makers, but the general rule is as stated. In a very few cases of watermarked papers the watermark can be read from both sides of the sheet, but the general rule is that the right side of the sheet is that from which the watermark can be read. In machine-made papers it is the upper side of the paper as it is made, but in hand-mades the right side is the under side which receives the watermark. The watermark is in reverse upon the mould or the dandy roll, and is fixed on the impressionable pulp by slight compression or displacement of the fibres. In papers without watermarks it may be taken that the smoother side is the right side. The wrong side of machine-made papers bears the impress of the woven wire upon which they were made. The wire mark is fixed by various means, such as the pressure of the dandy roll, the action of the suction boxes, and the pressure of the couch rolls. Blotting paper, although not subjected to all these forces, shows the wire mark so plainly as to serve as a

guide to what one may expect to find in other papers which are more highly finished. Looking along the surface of the paper will sometimes reveal this mark, when it is not possible to detect it by looking through the sheet. The wire for hand moulds is much coarser than the wire cloth of the machine, and as the pressure of the pulp is not great, and the fibre is moderately long, couching nearly obliterates the woven wire mark and makes it less easy to distinguish between the right and wrong sides of hand-made wove papers. In a laid mould the wires displace fibres, and the paper is immeasurably thinner at the places where the wires of the mould occur, but these are the only wire marks on the paper. A dandy roll makes the laid wire marks on the right side of machine-made paper in addition to the woven wire marks on the wrong side, so the distinction between right and wrong sides is easily made in machine-made papers. Papers made by the twin-wire method generally have the wire sides of the two plies brought together, so that there is no wire mark on the surfaces of the sheets. The smooth side of M. G. poster papers is the right side.

The wire marks assist one in distinguishing between hand-made and machine-made papers. It is clear that machine-made papers have a wire mark on the wrong side, even if laid or watermarked. The watermark of the hand mould is fastened over the wire, so the watermark will never show wire marks. Looking through the paper, observe whether the watermark has any small woven wire marks; if it has, it is undoubtedly machine-made. A laid paper which shows woven wire marks is, of course, the product of the machine.

Coloured papers may vary in shade on the two sides. This variation is more frequently seen in papers which are coloured by pigments than in those dyed with aniline colours. Blue papers, with ultramarine in their composition, tend to be slightly lighter on the wrong side of the sheet. The causes of this are different in hand-made and machine-made papers. In hand-mades the colour has a tendency to gravitate to the bottom of the mould, which is the right side of the paper, while in machine-made papers the action of the suction boxes is apt to draw some of the colour away from the under side, leaving the right side slightly darker. Thus difference in shade of the two sides is not a guide to distinguish between hand-made and machine-made papers.

To recall the methods of manufacture. The mould of hand-made papers receives a shake each way, felting the fibres evenly. The machine wire receives a side-shake which is only effective for a short period—as long as the pulp is in a state of suspension—and as soon as the water has drained away the shake ceases to take effect. Some fibres are crossed, but taking the web of paper, it is more easily pulled apart across its width than in the direction of its length. The fibres are fixed and are dried in a state of tension, so that most of the fibres lie in the direction of the flow (known as the machine direction or the grain of the paper), and subsequently expand but little in length, but are more liable to do so in width or diameter.

The direction of the fibres serves to distinguish between hand-made and machine-made papers. Tearing a piece of hand-made paper will result in ragged tears very similar both ways of the sheet. A piece

of machine-made paper shows a ragged tear in one direction and a much straighter tear in the other. The straighter tear is in the machine direction.

Strips cut from the sheets, one from each way, 7 in. long by 1 in. wide, held between the finger and thumb and allowed to incline at an angle of 60°, will behave differently according to the method of manufacture. Hand-made strips will keep together, because the fibres are equally distributed, while strips of machine-made paper will separate, owing to the difference in the direction of fibres. The strips should be inclined first to the right and then to the left to ensure correct conclusions. In machine-made papers the strip which remains erect during these inclinations is cut from the machine direction of the web.

If at the corner of a sheet a tear of 1½ in. is made about 2 in. from the edge, and a similar tear of the same length at right angles to it, a small square will be nearly torn out. When this is damped thoroughly on one side the free edge will curl more or less towards the sheet, and in some papers the curl will almost develop into a tube. The machine direction is parallel to the straight edge, which has advanced, as the curl takes place across the web (the direction of greater expansion).

Hand-made paper has four deckle edges, but imitation hand-mades also have these, and cylinder mould-made papers are similarly marked. Imitation hand-mades, being machine-made, are distinguishable by the means enumerated above, and comparison with the edges of known hand-made paper will be the quickest method of distinguishing between real and imitation deckle edges.

Papers made on the cylinder machine, and often sold under the title of " mould-made," are not easily distinguishable from hand-made papers. The deckle edges are not always alike on all four sides as they are in hand-made papers. Testing on the Schopper machine (*see facing* p. 133, Fig. 25), they will usually reveal a difference which it is not possible to discover from looking at the sheet. The German paper experts declare it impossible to differentiate with certainty between the two kinds of paper, while a papermaker who manufactures both varieties usually has but little difficulty in naming them correctly.

COMPARISON BETWEEN HAND-MADE, MOULD-MADE, AND MACHINE-MADE PAPERS

Tests made on Schopper Machine (see p. 131), Papers of same size and substance (107 grammes).

Description of Paper.	Stronger Direction.		Weaker Direction.		Mean of Two Directions.	
	Tensile Strength.	Elongation.	Tensile Strength.	Elongation.	Tensile Strength.	Elongation.
	Lb.	Per Cent.	Lb.	Per Cent.	Lb.	Per Cent.
Hand-made -	25.5	3.9	22.1	5.6	23.8	4.75
Mould-made -	26.8	4.8	20.8	4.7	23.8	4.75
Machine-made	26.5	3.7	16.0	5.7	21.2	4.70

The figures given are the mean results of five tests.

STOCK PAPERS

Selection of papers for stock purposes is not easy to undertake for others, therefore this section can only summarise the information of the earlier chapters and offer suggestions.

The stock room should not be an out-of-the-way room, dark and perhaps damp, but should be light, with ample room to move paper in bulk, so that issues as well as deliveries can be dealt with quickly. It should be possible to control the temperature and humidity of the paper warehouse if the paper is generally used for register work. A dry room is essential, or trouble will ensue, for in damp rooms tub-sized and coated papers will deteriorate, highly glazed papers will go back in finish, papers for colour work will be liable to vary in dimensions, and delay and loss will follow.

In a printing office where small quantities of paper are dealt with, the inconvenience of carrying paper in and out a few reams at a time may not be apparent, but considerable time is wasted and some loss in spoiled sheets results from such a method. Quantities of paper should be dealt with as expeditiously and with as little handling as possible. A transporter truck requires perhaps more room than is taken by a man or boy lifting reams, but it deals with thirty reams instead of two at a time, and in up-to-date offices time is counted as valuable as currency.

Large stocks should be kept in stacks; the counsel of perfection being that no paper should actually touch the floor, but stand on boards with a space beneath. If paper is moved in and out of the warehouse by transporter trucks it will stand on the platforms supplied and be available for moving rapidly to the machine room. Smaller stacks will be ranged in racks or on shelves so arranged as to be easily accessible, the larger papers nearer the floor, and the smaller papers, which can be handled more easily, on the higher shelves.

The arrangement in classes is advised, writings, printings, coated, coloured papers having definite positions, the sizes also being arranged for ease of handling. Each section, size, and variety should be clearly marked to ensure accuracy and economy in issue as well as in keeping stocks up to correct strength. A new arrival should not be dumped down anywhere, but should take its place in the proper section, be considered as valuable material, and handled accordingly. Coated papers generally and imitation art paper mark and crease badly if carelessly handled, but if all papers are treated carefully it will not be necessary to give instructions for handling special papers.

Papers are received from different mills packed in different ways. If reams are received in bales, it is usual to unpack and to stack in single reams, as subsequent handling is easier in the lighter weight. Heavy papers and boards are packed in quantities smaller than reams to facilitate removal in and out, paper in half or quarter reams, and boards in packets of 100, 144, or 250. The method of packing reams or parcels is sometimes excellent, but at other times it leaves something to be desired. If the wrappers are not strong enough for the paper contained, they break as the reams are moved, and the edges of the paper are likely to become damaged. Fastening is done with paper tape, webbing, or string, according to the size and weight of the parcels. The ends of the wrappers should not be carried to the upper side of the parcels but should be turned in, so that the thickness of the packet is not increased at the ends. Paper tape is generally found suitable for most papers, and it is essential that the width should be ample. If excess

of moisture is used on gummed tape some cockling of the contents may result. Cotton tape or webbing is adopted in some cases, and string may be necessary only for the heaviest papers. If string be used, it will be necessary, before stacking, to see that the strings are not greasy. If soiled string has been used it must be removed and the reams again fastened, or the grease will penetrate and spoil a portion of the contents.

Broken quantities should always be tied up, preferably with tape, and the quantity marked on the wrapper, correction being made as quantities are withdrawn.

Letterpress printers prepared to execute all classes of work must of necessity carry a more varied stock of papers than those who specialise on one or two lines. It is convenient to have printing papers in several qualities and weights, the sizes being governed by the sizes of machines available. With a double demy cylinder machine it is not wise to stock quad demy paper; but allowing that as the limit (a small one nowadays) printing papers in double demy, double crown, and royal will be safe sizes. Poster papers, both ordinary and M. G. finish, should be stocked in the full size of the capacity of the machines.

Super-calendered papers should be carried in comparatively small quantities, unless they are to be used quickly, as high surfaces deteriorate when stocked for a long period. Art papers are better for being stocked a reasonable time, as the coating becomes fixed and there is less likelihood of picking at machine. Tinted papers are accumulated gradually, the colours and sizes most in demand being placed on stock.

Cover papers must, of course, follow the white papers for sizes: the cover for demy works is medium, and the royal is cut larger (20½ in. × 25½ in.) to cover an ordinary catalogue. In this class of paper, too, sizes and colours are governed by prevailing consumption.

In making a selection of writing papers, unless one is a very large consumer, a safe course for the better classes is to make a selection of watermarked papers. There is no virtue in a watermark as such, but the wholesale stationer is able to keep known papers up to standard, and also is able to meet all reasonable demands from stock. The prevailing sizes for writing papers are foolscap, post, large post, double foolscap; for account book work, demy, medium, and royal (in writing sizes), and imperial. Writing papers in cream wove, cream laid, azure laid, yellow wove (another term for azure wove), blue laid, and blue wove will be required. It may be necessary to keep a small stock of hand-made papers for documents of importance. Banks in medium, large post, and double foolscap are stocked if required. Engine-sized writings are suitable for much printed work, but for stationery of good appearance, tub-sized papers should be stocked. Large post writings in four weights will be useful stock, with other sizes in equivalent weights. Double large post is desirable in all engine-sized writings, and frequently in tub-sized papers, when obtainable. The usual weights for bank papers are foolscap, 14 lb.; large post, 22 lb.; medium, 26½ lb. per 1,000; but thinner papers are obtainable. Bond papers are similar to banks but heavier in substance, and experience will teach what substances and sizes should be stocked. Account book papers follow custom as to weight,

and these are usually kept in azure or blue laid, tub-sized, and air-dried. Hand-made papers are necessary for many books which are in constant use, to ensure the permanence of the records. Engine-sized account book papers are not recommended for stock, although the papers are suitable for much work of a temporary nature. Tinted writings can be obtained in great variety, and reference to the sample books of the wholesale houses will serve to guide in making a safe stock selection.

Only small quantities of gummed paper should be kept, demy being the usual size, and a paper (ungummed) about 36 lb. per 1,000 is a fair quality. All gummed paper is prepared in such a manner as to minimise liability to curl during printing and other operations.

Stock boards will usually be royal in size. Good qualities of paste boards, two substances of ivories, a full range of pulp boards in various tints will be a useful selection. Thicker boards, useful for show cards, are stocked in royal and imperial, one-sided white boards, one-sided coated and two-sided coated, in 10 and 12 sheet substances, should be kept in small quantities.

The lithographer requires litho. papers of various substances and qualities in sizes to suit the machines of his establishment. The lithographer can frequently transfer several jobs on to one stone or plate of the full size of the machine, and work more economically than by using papers and machines of smaller sizes. For black work a fair litho. paper in several substances should be stocked, for colour work a heavier paper of good quality in one or two substances only, and small quantities of plate, plan, chart, and chromo papers

will be required. All the writings and miscellaneous papers mentioned earlier will be included in the stock warehouse of the lithographer.

Stock accounts should be kept very carefully. Employers should insist that paper drawn for making ready, for proofing, and for set-off sheets is accounted for as accurately as a ream of hand-made paper. It is only by adopting a system of accurate accounting that the balance between receipts and issues can be maintained. No issue for replacing spoiled sheets should be made without an entry to that effect in the stock ledger. Whether a card index system or a paper stock ledger with receipt and issue sides be the method of accounting, it should be possible to check the state of the stock at very short notice. The entries will be in this or similar form. Prices are kept separately, unless it is preferred to keep them with the stock details:—

DESCRIPTION—*Printing Double Demy, 56 lb. per* 1,000

STOCK NO. 25. *Purchased from* SPALDING & HODGE

RECEIPTS.			ISSUES.			
Date.	Quantity. Sheets.		Date.	Job No.	Quantity. Sheets.	
		000				000
Jan. 2, 1939	101	500	Jan. 5, 1939	172	15	450
Mar. 10, ,,	72	250	,, 10, ,,	197	4	280
Apr. 1, ,,	18	800	,, 13, ,,	221	17	940

At the time of stocktaking it should not be necessary to close the stock room, but if done gradually, starting a few days before the end of the year (or other period),

the stocks are taken and each stack as checked is marked, and issues up to the end of the year entered on special slips or cards placed in the stack. On the day of stocktaking it will not take long to adjust the book of balances with the additional entries. If a discharge has been given for every issue of paper, either by work sheet or by a requisition from the various departments receiving the stock, the balances should be correct.

In order that sample sheets may be shown to customers, and to avoid frequent requisitions for single sheets of paper, a few sheets of all stock papers should be issued for a sample portfolio, and these folded to a convenient size, each sheet marked with stock number or description to prevent confusion. Reference to stock lists will furnish price, quantity in stock, and other necessary particulars.

A separate account should be kept of off-cuts, which accumulate rapidly. Some can be cut to useful sizes, and it is frequently more economical to trim them at once to the nearest regular size, to parcel them, and to mark the contents on the wrapper. A corresponding entry should be made in the oddment book and issues duly noted. All jobs worked on off-cuts should be charged as though the ordinary stock for such jobs had been used, and the charge sheet and invoice should show that oddments have been issued, or it may be difficult to explain change of paper or price when repeat orders are executed.

Subdivisions of Paper.—The regular divisions of a sheet of paper, whether by folding or cutting, are obtained by halving the longer side. Thus, folio, quarto, octavo, sexto-decimo, trigesimo-secundo, sexagesimo-quarto are obtained by dividing the longer

side of the whole sheet and the anterior sizes as shown in the diagram.

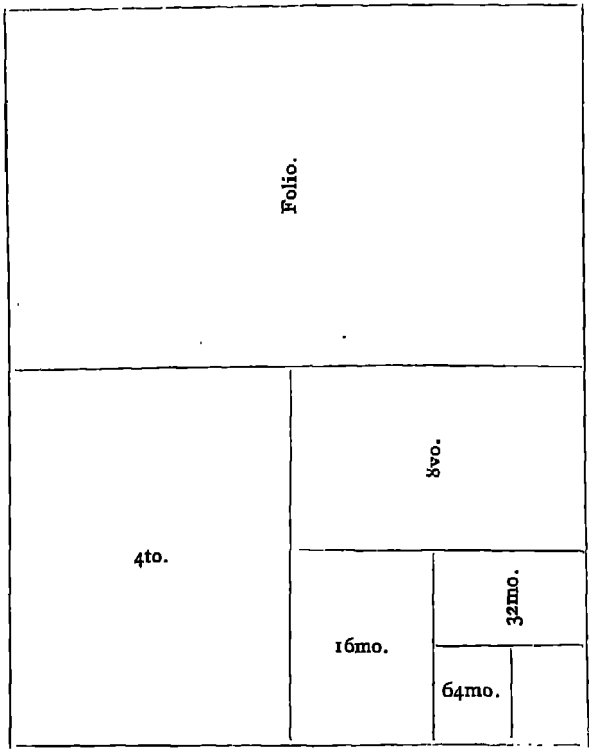

Diagram showing regular (or broad, or common) divisions of a sheet of paper.

Regular divisions may also be referred to as broad or common folio, quarto, etc. *Long* divisions of the sheet are effected by halving the shorter dimension of the sheet for *long* folio, and for each of the succeeding divisions by dividing the shorter dimension of the

regular divisions, thus *long* octavo is obtained by dividing the regular quarto (*see* diagram) by a vertical line, which conforms to the formula just specified.

Other divisions into slips may be long slip or short slip, followed by the numerator, *e.g.*, long slip 4to, short slip 8vo, indicate that the length of the slip is the long or short measurement of the sheet, divided into four or eight, as denoted. Subdivisions which are multiples of 3 admit of various methods of folding or cutting. It must, therefore, be insisted that when a work is to be duodecimo in size, the dimensions in inches should be stated in order that there may be no risk of error. All the possible subdivisions of 24mo cannot be detailed here, and it is far more practicable to adopt *regular* divisions and to use paper of special size if necessary.

The subdivisions of cardboards will be made by cutting the regular divisions already indicated, or to the sizes of cards as set out on p. 152.

The model estimate form used by printers includes a provision for deficiency or excess quantity, but it should always be the aim to keep as closely as possible to the quantity ordered. Therefore the issue of paper for any and every job should provide for the spoilage attendant upon the various operations through which the paper will follow in the works. No rigid scheme of percentage allowance can serve for every class of work. Five hundred copies of a job, quarto in size, printed on both sides, produced on a platen machine, will call for sufficient paper cut and trimmed to size. Few guillotines can be guaranteed to deal with small quantities of paper without some damage to the bottom sheet. Thus, in addition to the net quantity of 125 sheets must be added allowances (in copies) for each

of the following: Cutting, 4; printing, each side, 4; folding, 2; specimen and file copies, 6; a total of 20 copies, or 5 sheets, making an issue of 130 sheets. That is an allowance of 4 per cent. for a small job, printed on two sides and folded, and the calculation will serve as a rough guide for many jobs. For long runs in a single colour it will be found that 1 per cent. is an ample allowance. Automatic feeding contributes to accuracy, and with a reliable counter on the printing machine, it may be found that less than 1 per cent. may be sufficient to produce correct numbers. For colour work the risk of spoilage is much greater than in work of a single colour. For a moderately short run in several or many colours, 5 per cent. for each working may be necessary to cover spoilage, and to ensure the full number of copies after sorting out copies in which register or colour values are defective.

A scheme of allowances can be drawn up, remembering to make provision for all possible operations. If any of the work has to be done in a separate establishment, a larger margin should be allowed than in the parent works. With the general principles defined, it is advisable for each establishment to keep records and to base scales of allowances upon the results of such accumulated knowledge, and upon the efficiency of the staff.

It is clear that no "ream" can provide for all eventualities, and the adoption of the sheet as the unit, for that is what follows upon the packing of paper in 1,000's, is both rational and economical.

DURABILITY OF PAPER

Paper is used for many publications and jobs of an ephemeral character, and for these the permanence of paper is never in question. On the other hand, ledgers, leases, agreements, share certificates, must be upon paper which is capable of resisting a good deal of handling, and is to all intents and purposes permanent. Printed records, too, must be preserved on paper that will, with ordinary care, be indestructible.

The constituents of paper, as shown in the first chapter, are vegetable fibres, mineral filling, colouring matter, and vegetable or animal sizing. The fibres constituting the paper which approximates most nearly to a pure cellulose material, with the minimum of chemical and mechanical treatment, are, of course, the best possible. Classified with that in view, cotton, flax, hemp, chemical wood, esparto, and mechanical wood is the order of merit. Cotton is, more than any other fibre, the ideal fibre. It contains 91 per cent. of pure cellulose, has a comparatively small amount of encrusting matter, and its fibre is easily bleached and easily prepared for papermaking. Consisting as it does of seed-hairs, cotton is a free fibre from the first. It consists of a long tube, of dumb-bell section, with a tendency to twist upon itself. Prolonged beating produces numerous fibrillæ, and the softness of the original fibre is preserved until over-beating is reached. The twisting, the division into fibrillæ, make for strength, good felting, and, with the softness in addition, the best and most durable papers are those of cotton.

The flax fibre is a bast fibre. Its yield of pure cellulose is 70 to 80 per cent. The fibre consists of a thick-walled canal, which is easily seen in the unbeaten state. Beating tends to crush and remove the early characteristics. The fibres are regulary rounded or polygonal, and easily split into numerous fibrillæ. The ends of the fibres beat out into bunches of small fibres, and these, together with the nodules which occur on many of the fibres, produce strength in the paper. The flax fibre is straighter than the cotton fibre, and so linen papers are stiffer and harder than cotton papers.

Wood, produced as fibres by chemical means, consists largely of tracheids, long ribbon-like cells, which are easily broken into shorter lengths. It is not possible to subdivide the fibres longitudinally by prolonged beating. This only tends to shorten the fibres. Hence Mitscherlich,* or similarly produced wood pulp, gives strong, tough papers, unattainable by those pulps which are strongly bleached and much reduced. The tracheids, being smooth and flat, do not tend to make soft papers, but blended with rag or esparto fibres, excellent papers may be produced. Only 50 per cent. of fibre is produced from the original wood.

Esparto gives a smooth, cylindrical fibre, pointed, short, small canal. Being small, the fibres do not receive much treatment in beating. Separation and cleaning are the principal aims of the preparatory stages. Esparto is, to the papermaker, synonymous with bulky papers. The best of printing papers, litho.

* Mitscherlich process: boiling for a long period under low pressure, afterwards disintegrating the fibres by means of the edge-runner.

papers, and featherweights are composed largely of esparto. It blends well with the preceding fibres, and especially with chemical wood for printing papers. Esparto papers are not high in the scale of papers in respect of resistance to wear, and the cellulose is inferior to that of cotton and flax. The yield of cellulose is low—42 to 47 per cent.

Mechanical wood is lowest in the scale of paper-making materials. Chemically it is impure; structurally it consists of chips and fragments, seldom complete fibres. Ground into short lengths, it consists usually of short bundles of short pieces of fibre. It does not felt well, and requires some longer fibres to assist it in papermaking. Ten to 40 per cent. of chemical pulp will usually be added to mechanical pulp to make it more lasting and less brittle. Such papers should not be employed for anything but ephemeral work.

In 1898 a Committee appointed by the Society of Arts reported upon the deterioration of papers after extensive investigation. Their conclusions hold good to-day, and may be summarised in the next few paragraphs.

The deterioration of paper may be by discoloration only, or disintegration may also occur. Discoloration may be caused simply by the action of the atmosphere, and is to be seen in the margins of books and in coloured papers. The outer margins of books are more susceptible to oxidation than the interior, and in gaslit rooms most books will in time suffer from discoloured margins. Chemical residues from the manufacturing processes, if left in the paper, will bring about changes in colour, engine-sized papers

being more liable to change than papers which are tub-sized. Papers which contain esparto, straw, or mechanical wood, will in chemical laboratories certainly become discoloured, as aniline and other coal tar bases stain the papers pink or yellow. There are but few colouring matters which are absolutely fast, therefore most tinted and coloured papers will change in time.

Loss of strength may be due to impurities in paper, such as residues of the chemicals used in the preparation of the pulp, to the impurities in the pulp itself, or to the use of gas as the agent for lighting and heating. The use of china clay for the improvement of the surface of the paper and for the increase of opacity tends to weaken the paper, not by any chemical reaction but merely by rendering the paper less resistant to wear. The attainment of extreme whiteness by bleaching is sometimes obtained at the expense of durability, as products are sometimes left in the fibre which will cause deterioration and discoloration of the paper.

The classification of the fibres has been referred to, and the four classes are: (i) cotton, flax, hemp; (ii) chemical wood; (iii) esparto and straw; (iv) mechanical wood.

For written documents of permanent value the paper should be all-rag fibre, without starch and loading, tub-sized with gelatine. For printed books to be preserved as of permanent value, not less than 70 per cent. of the fibre should be rag, the loading should not exceed 10 per cent., as shown in the ash of the paper, and the sizing should be effected by not more than 2 per cent. of rosin.

The wearing qualities of paper are affected by

the method of manufacture as well as by the constituents. Blotting paper, which is an all-rag paper, will soon wear away, owing to the fact that the fibres are cut short and loosely held together without sizing. If the paper were heavily rolled it would reduce its usefulness as an absorbent paper. Featherweight papers are made entirely of esparto, finished to produce as bulky a paper as possible, consequently the fibres are not well rolled together, and the books printed on such paper are anything but durable. Imitation art papers give a mineral residue of 25 to 35 per cent. on ashing, and have very little strength, owing to the large proportion of china clay present.

The Library Association, after prolonged inquiry, issued a report in 1930 regarding papers suitable for bookwork. Strictures were passed upon featherweight and coated art papers, from the librarians' point of view. In order to secure high standards of permanence and durability in books worthy of preservation, it was suggested that grades of paper were obtainable which would assure those characteristics without undue expense.

Three varieties of paper were scheduled as Grade 1 (*a*), hand-made, all-rag, tub-sized; Grade 1 (*b*), machine-made, all-rag, tub-sized, or engine-sized, or both engine-sized and tub-sized; Grade 2, chemical wood pulp, engine-sized. An intermediate grade might be possible, consisting of an admixture of rag and chemical wood pulp. Mineral matter as loading not to exceed 6 per cent., rosin content not more than 2 per cent., and the lowest possible amount of alum consistent with fairly hard sizing.

Art papers do not fold or stitch well, as the mineral

coating, although firmly fixed to the paper, behaves as a non-fibrous material might be expected to do, breaking down, and the paper beneath tends to give way too. If kept in a damp place, art papers absorb moisture at the edges, and in the presence of a large amount of moisture the sheets will stick together. Rag art papers are procurable (the body being a rag paper), and possibly it will be found that such papers, kept from air and moisture, will be very durable.

Papers containing a large proportion of mechanical wood, whether coated or otherwise, are liable to deteriorate rapidly. A newspaper exposed to sunlight for a day or two becomes discoloured and brittle, the deterioration being less rapid if exposed to light and air without the sun. For this reason papers containing mechanical wood should never be employed for work which is required to endure.

While the foregoing will in some respects appear as a counsel of perfection, it must be recorded that many prophecies regarding the disintegration of papers have been falsified. In 1824, Johnson's "Typographia" contained a note bewailing the fact that the deterioration of paper was very serious. From time to time in the technical and lay press there have been expressions of opinion that papers containing anything but rag fibres would speedily decay. Art paper has been condemned to a very short period of existence, and there have been general condemnations of papers made from the wood pulps and from esparto.

The facts are that any material, even the best obtainable, will fail to produce a durable paper if the chemical and mechanical treatment accorded to it attacks and degrades its cellulose. Doubtless there

are papers manufactured since the development of substitutes for the rag celluloses, which have been made of good raw materials, which have received such drastic treatment in boiling or bleaching that the fibres have been debased before conversion into paper. Thus it behoves the papermaker to supervise his manufactures and to avoid treatment which will imperil the material he is using. Comparison between standard papers and the later manufactures requires to be made frequently, records of all stages of production kept, and care exercised in acceptance of raw materials of doubtful character. The storage of books and documents under unsuitable conditions will militate against durability. The best paper subjected to damp, excessive heat, or chemical fumes will not fail to suffer deterioration of strength and colour. Thus all who handle paper in any form can contribute to the well-being of the products of the paper mill.

DEFECTS AND REMEDIES

Many users of paper look upon that material as being perfectly inert and stable, always of the same quality, and any defect which may arise remediable only by changing the paper. Unfortunately, the printer who uses the paper for letterpress, lithographic, intaglio, or ruling purposes finds that paper is not unchangeable, and when work has to be registered upon the paper difficulties often arise, and exchange is not always possible.

Difficulties arise from expansion, cockling, creasing, curling, from the surface lifting or picking, from

the paper being out of square, from electricity contained in the paper, and from loose particles coming away from the paper in the form of fluff. In addition there are difficulties in getting inks to dry upon certain papers, and in obtaining a solid impression or continuous line from printed or ruled matter.

Reference to the methods of manufacture of machine-made papers will serve to give the clue to some of the difficulties, and may suggest the remedy. The pulp, diluted with a large volume of water, consists of innumerable fibres, their length being at least 100 times their diameter, and, as is the case of all water-borne bodies travelling in a fast stream, they take up the position in which their length is parallel to the direction of flow. The side shake of the wire alters the position of some of the fibres, and although the alteration is permanent, the majority of fibres remain in a position parallel to the machine direction of the web of paper. Most machine-made papers are dried on the heated cylinders of the paper machine, the draw of the cylinders being arranged to allow for the consequent contraction of the web, but the fibres are not given the opportunity to adjust themselves as in the case of air-dried papers.

Paper which is properly stabilised contains water equal to about 7 per cent. of its weight. Without this moisture paper would be brittle, and when this amount is exceeded the paper expands. But paper, as it leaves the calender rolls of the paper machine, contains much less than 7 per cent. of water. It is essential that all the water should be dried out of the paper, and it is sometimes reeled almost bone-dry, but if the paper is to be super-calendered it is damped before

eeling, and left until it mellows before calendering. Conditioning units are employed in some paper mills for the purpose of returning to the paper the quantity of moisture which is essential to render the paper stable. This is effected by passing the web of paper through a compact machine where moisture properly controlled is absorbed by the paper. After reeling the operations of cutting, sorting, and packing follow. But many papers are cut and packed without much opportunity for attaining a degree of stability which should be maintained during its manipulation by the printer.

All papers have some spaces between the fibres, sometimes partly filled with sizing and loading, but always containing some air space, the amount depending upon the density of the paper. Heavy or dense papers and light or bulky papers are the extremes, 30 to 70 per cent. of air space being examples of the two ends of the scale. The fibres, when expanding, are to some extent accommodated in the spaces between the fires.

Vegetable fibres expand both in length and in diameter. The maximum expansion is in diameter. It has been shown that the majority of the fibres lie in a position in which the length of the fibre is coincident with the length or machine direction of the web of paper. Thus the maximum expansion of paper will be across the web. Experiments carried out on various papers resulted in a range of figures between 2 and 4.5 per cent. ot expansion across the web of the paper, and from .1 to .8 per cent. in the machine direction of the paper.

Expansion (or stretching, as it is wrongly termed)

is caused by absorption of moisture by the finished paper from the atmosphere. The atmosphere always contains some moisture, the amount varying not only from day to day but from hour to hour. When there is an excess of moisture in the air, as on wet days or when fogs occur, paper will readily absorb the extra moisture, and the absorption will be accompanied by expansion of the sheet, principally across the web, or, as it is generally termed, in the cross direction. This propensity of paper really points to the remedy. Paper should be exposed before use to an atmosphere which will stabilise the moisture content of the sheets, and the air of the machine-room should conform at all times to the same conditions.

Few printers treat the machine-room, letterpress or lithographic, or the ruling-room as places where scientific conditions should be maintained. The use of the wet and dry bulb thermometers in other factories is for a definite purpose, to indicate the state of the atmosphere, and to guide in regulation of temperature and humidity, in order that the manufacturing processes may be carried out under scientific conditions. But the machine-room of the printer, closed for more than half its time, heated perhaps by hot water or steam pipes, sometimes hot, sometimes cold, in wet weather damp, in summer alternately very dry and damp, no wonder that paper expands, contracts, and causes trouble at machine.

The establishments where scientific conditions are observed reap the benefit in increased output, because less time is spent in getting work to register, and less work is spoiled by bad register. Even with the regulation of atmosphere suggested by the use of the

dry and wet bulb thermometers or hygrometer, the paper must be *in the machine-room*, that is, the paper must be exposed in order to allow it to absorb moisture if too dry, and to part with moisture if too damp, so that the paper may be as stable as possible while the condition of the machine-room remains constant. It is important that the amount of atmospheric moisture should remain constant, and specialists will advise on the means of attaining this end.

Various methods may be adopted for suspending paper. In some cases the paper is hung over lines, about a quire at a time, exposed to the atmosphere and dust of the machine-room. Hanging frames are supplied by vendors of printers' supplies, in which the paper is clipped by a ball or swinging lever, and about a quire is held in each of the clips, a perpendicular position minimising the danger of dirt. By use of these frames a large quantity of paper can be treated in a comparatively small space.

There are various mechanical devices for seasoning large quantities of paper in the machine-room. Conditioning machines are available in various designs according to the quantity of paper to be dealt with and the space available. Paper is suspended by clips and travels in a circular chamber while a fan circulates air drawn from the press-room through the paper. The capacity of the machine depends upon various factors, but in the machine illustrated, 12,000 sheets, 40 in. × 60 in., may be seasoned in two hours.

All paper, after it has been thoroughly exposed, must be stacked, a board and a heavy weight placed on the top of the stack, and the edges protected from getting dirty. Paper so treated will keep in condition

for a fair time, from which it can be deduced that if stacked before it has an opportunity of becoming stable, paper will require to be kept in stock a long time before it can be considered fit for use for register work.

Stretching takes place when paper is subjected to tension or rolling. All cylinder printing machines exert these strains, from the pull of the cylinder and from the printing surface. All papers are elastic, and if stretched just within the bounds of the breaking strain of the paper will show some elongation, permanent or temporary. If the paper returns to its original length there is no permanent stretch, but that is seldom found in practice. The greater expansion of paper is in the cross direction, and the direction of greater stretch of the sheet coincides with that of the larger expansion.

Careful tests of good litho. papers on the Leunig Paper Tester show them to have a mean temporary stretch of 2½ per cent. in the machine direction, with a stretch that is permanent of .68 per cent. The figures for the cross direction of the paper are 4 and 1½ per cent. respectively. It is the permanent stretch that may cause inconvenience, but the figures quoted must not be taken as an indication of what takes place when printing. A properly adjusted machine does not exert the tension that would be necessary to obtain the percentage of elongation shown above. The fact that lithographic papers are cut with the cross direction coincident with the narrower dimension of the sheet is sufficient evidence that it is not the machine tension which gives rise to register trouble.

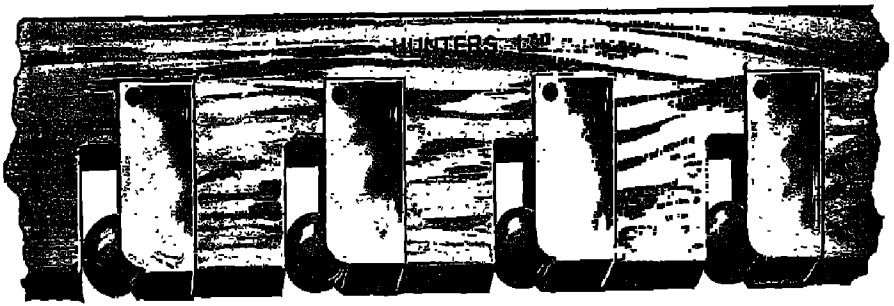

FIG. 19.—BALL FRAME FOR HANGING PAPER.

[*To face p.* 120.

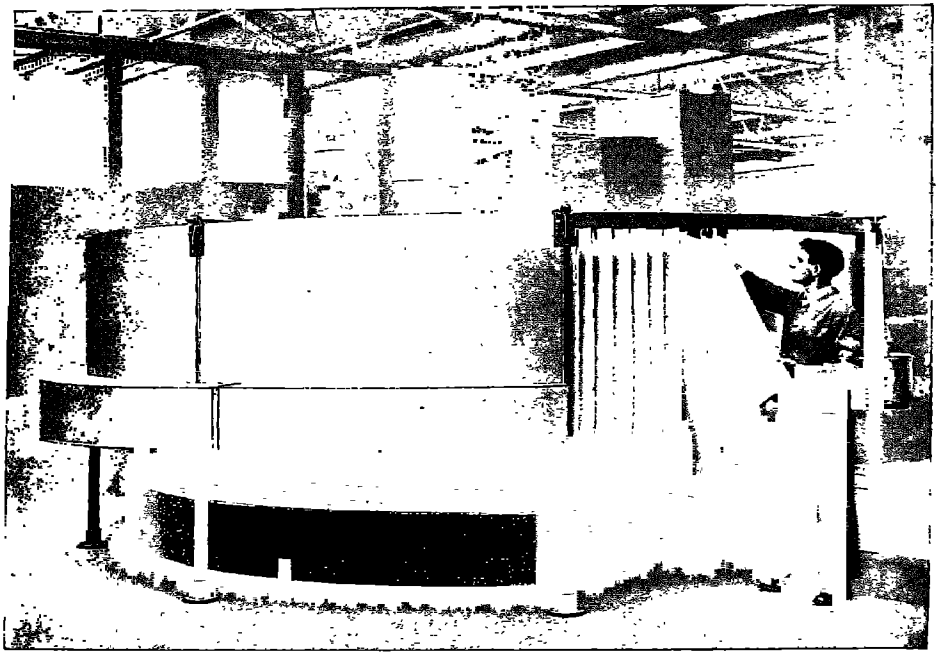

FIG. 20.—CIRCULAR TYPE PAPER SEASONING MACHINE (*Strachan & Henshaw Ltd.*).

[*To face p.* 121.

Writing and most printing papers, which may or may not be printed in more than one colour, are frequently cut two ways of the webs, that is, a 30 in. × 40 in. paper, if cut from a web of 70 in. net width, is cut without waste by cutting sheets 30 in. wide from one part, and 40 in. sheets from the remainder of the reel. All papers on which register work is to be printed must be cut with the same machine direction. In ordering paper which is not generally used for work in several printings, the printer should be careful to point out the purpose for which it is intended, and ask that the instruction shall, if necessary, be passed on to the papermaker.

Cockling in paper is caused by the paper being drier or damper than the atmosphere, and shows that there is unequal expansion of the sheets, and exposure as detailed above should be tried as a remedy. Cardboards which are cockled may or may not improve upon exposure to the atmosphere. The thicker the cardboard the less likely it is to alter its shape. Usually the fault will have arisen through severe drying under tension stretching the boards, and drying while unequally stretched. The cockling and wavy edges of boards are frequently found to be permanent faults.

Paper which has been packed in cases or boards will sometimes exhibit cockled sheets at the top and bottom of the parcels, due to the use of damp boards. Removal of the cockled portions will be necessary, and the fault may dry out.

Creasing.—Paper intended for printing on any machine employing a cylinder or cylinders for imparting impression must lie perfectly flat, and if in reel

it must be equally true throughout its length. Even when the sheets are perfectly flat and free from cockling, creasing may develop during passage through the machine. The printer will attribute the fault to the paper, but the user should realise that unless the impression cylinder and the printing surface are correctly adjusted there is a risk of imperfections developing. Should a cylinder be out of truth, either in itself, or by reason of packing, it is not and cannot function as a true cylinder, and is liable to produce distortion in the paper which passes through. A rubber-covered cylinder presents a resilient surface, and if excessive impression is imparted by it, distortion of the paper will probably follow. This can be demonstrated by any pair of rolls, however small, one being rubber covered, creases following excessive pressure. All machinery dealing with paper must be as accurately adjusted as are the calender rolls of the papermaker, which are ground to exact dimensions in order to produce paper which, when cut up, will lie perfectly flat. When creasing occurs in letterpress jobs with full borders, the foregoing should be explored.

Wavy edges to the paper, if at the feed edge, will frequently cause bad creasing, from which damage to the printing surface may result. Creasing from defects of the machine, make-ready, or printing surface must not be visited upon the papermaker. If the paper will not respond to exposure to air, feeding the narrow way of the sheet may overcome the difficulty, or, if the size of the machine permits it, cutting the paper in half and rearranging the forme or other printing surface and putting on an extra feeder.

Curling in papers causes delays in printing and

ruling when the paper curls up at the ends and makes feeding into the machines difficult. Manufacture may contribute to this fault, formation on the wire, sizing and drying being factors in the development of curling. Undue dryness of machine-rooms may also give rise to the trouble, and it is in the direction of constant humidity that remedy is to be sought.

Picking, or lifting of the surface (sometimes termed plucking), is a fault which may arise in art and other coated papers which have the coating fixed to the paper with glue. The fault is caused by the coating being insecurely fastened to the body paper, the trouble being temporary or permanent. Storing the paper in a damp place will weaken the adhesive properties of the glue, and the coating will not stand the pull exerted by the printing surface, but will come away in places. The paper may be improved by suspending it to dry off the excess of moisture, but if heated air is used, the temperature should not exceed 90° F. Newly coated papers may cause trouble, owing to the adhesive not being quite hard, and keeping in stock for a fair length of time, a month or two, may result in an entirely satisfactory issue. But if the papers must be used, seasoning, as already described, with a careful use of heat, will usually remove the trouble altogether. Slight modification of the ink may be necessary, and should be tried before condemning the paper altogether.

It will be found occasionally that the coating is not properly fixed to the paper, owing to insufficient glue, or a soft-sized body paper being used. Damp the thumb and press on the coated paper, lifting it a few seconds after. If a large part or the whole of the

coating comes away, the coating is at fault. Crumple a piece of the paper, treating it rather severely, and note the amount of coating which has left the paper when flattened out again. A large amount of dust indicates bad coating. Comparative tests should be carried out, a sample known to be satisfactory being tried by the side of the suspected sample.

Paper out of square may be due to faults in cutting in the paper mill. It will be evident when one edge of the paper is not quite true; folding a sheet in half, with the short edges coincident, will show the extent of deviation from squareness. For ordinary purposes it may not be material if one edge of the paper is one-eighth of an inch out, but if the sheet has to be backed up, care must be taken to feed the longer side into the grippers and to place the side lay, when backing up, at the opposite side exactly at the same point as when first fed. This, of course, is the printer's rule, and in such cases it must be rigidly observed. When paper is fed to the narrow edge, as when two sheets of demy are laid on a double-demy machine, the square edge must be the lay edge, or the register of the backing forme will be impossible. For colour work the only safe rule is to trim the two lay edges of all the paper, and, if necessary, to use a larger paper to allow for the trim.

Electricity in paper causes delay in feeding, the sheets sticking together, resulting in decreased output and spoilage from offset. As the paper is reeled at the end of the papermaking machine, electric sparks are frequently to be observed, owing to the electricity generated by friction of the dry paper. A large quantity of the electricity is extracted, but some thin

papers with high surface will retain a fair amount, and sheets cling together. Paper which has been exposed for maturing will not give this trouble, and thick papers, even if electrified, do not usually call for special treatment. Elaborate methods have been suggested for discharging the electricity in the paper, but it is a difficult matter. Various devices which heat the sheets immediately after printing are liable to set up other troubles. The most satisfactory apparatus is Chapman's Neutraliser, which, operated by alternating current, neutralises the static electricity in the paper. Conductor bars are fitted on each cylinder printing machine, usually at several points on the machine.

Fluff or dust may give trouble when papers which are loose in texture are subjected to friction, even of the lightest description. As such paper is usually soft-sized, the fibres are held together loosely, and the paper in its passage through the printing machine gradually deposits its loose fibrous dust upon the various parts of the machine it passes, and also upon the forme, and, in due course, upon the whole of the ink-bearing surfaces. As a consequence, the machine becomes covered with dust, the oil holes are clogged, and the ink is loaded with fibrous material and frequent washing up becomes necessary. These papers are unsuitable for lithographic printing, and the letterpress printer consumes most of such papers. Soft papers with the mill cut are slightly rough and give off dust, and trimming all edges reduces the liability to fluff, but cleaning up at machine forme, rollers, and ink slab or drum will be necessary more frequently than is usually required. When the machine is stopped for washing up, all parts of the machine carriage which

can be reached should be wiped free from dust, as the accumulation will find its way to the rollers when the machine is in motion.

Reeled Papers have their own special faults. A web of paper which is uneven in substance across its width will produce reels which vary in tightness of reeling. The web, being slit into two or more narrower reels, will produce tight reels where the substance is the greatest, and slack reels where the substance is lower. Weighing reels made at one time will corroborate the existence of the fault. Such reels should be dealt with in the press-room with care, and the tension maintained. There is little need for joins to give trouble if properly made. The mill staff is quite able to produce perfect joins, both as regards the join itself and freedom from improper adhesion of the web owing to careless use of paste.

Inks appropriate to the paper will prove the solution for difficulties in printing on hard papers, and also on very soft papers. It is outside the scope of this work to deal with printing inks, but in regard to coated papers it will be found that all such papers do not behave alike. Some take the ink readily and retain the fullness of colour, while others absorb the varnish and leave the dry colour on the surface. The latter fault is owing to the absorbency of the coating, and ink must be treated so that the surface absorbency of the paper is satisfied, and yet the colour and medium remain more on the surface of the paper.

Ruling on papers with hard surface is rendered less difficult by the use of a small amount of gall in the ink. For hand-made papers the ink always requires such manipulation, while for other tub-sized papers a

little gum arabic in addition to the gall will render even ruling more easily attainable. In ruling engine-sized papers a small amount of gum arabic and carbonate of soda (ordinary washing soda) will make the colours lie better. Additions to ruling inks must be made with discretion, lest other troubles be set up. While all work can be done on the pen machine, papers with soft surfaces, blottings, duplicating, metallic, and coated papers generally, will give the disc machine opportunity to prove its superiority for this class of work. Cockled papers and very thin papers can be dealt with successfully at the ruling machine by a little manipulation of the pens and feed.

Although rolling, hot or cold, may be effectively used for giving finish to the printed work, the paper is subjected to such great pressure that it is liable to distortion. As pointed out earlier in the chapter, stretching of paper is not equal in both directions of the sheet, and it is advisable, in order to preserve the strength of the paper, to roll in the same direction as the paper was made and rolled in the papermaking machine. Discover the machine direction by the methods described on pp. 96-97, and feed the paper to the rolling machine in the same way as it left the papermaking machine.

Unpleasant smell is a fault which may be present, or may develop in tub-sized papers. A preservative of some kind is frequently added to the sizing solution, but if the gelatine has commenced to decompose the smell will be at least unpleasant. Coated papers contain glue in the coating mixture, and are liable to the same fault. Printers should be careful when buying job lots of tub-sized or coated papers that the cause of the inclusion

in the job list is not smell, for a customer cannot be expected to accept a big parcel of printed matter for circulation which is offensive to one of the finer senses, and therefore not likely to prove persuasive to the recipients.

Deterioration of paper has been dealt with already, but there are faults unwittingly developed in some paper which can be avoided by the application of a little forethought. The colouring matters of papers are affected by various things. Some blue colours are discharged (bleached) when acid in any form comes in contact with them, others behave similarly when alkali is encountered. Some buff papers are altered in shade or even in colour by the same agents, and other colours are affected by some but not by all acids. It is not proposed to examine the composition of the colours used by the papermaker, but to point to instances where care is required. When the printer or manufacturing stationer is covering straw boards, box boards, or mill boards with coloured papers, paste or glue may be employed as adhesive, and these are always liable to become acid. To avoid change of colour the use of freshly prepared paste or glue should be adopted, and with as small a quantity of water as is possible. Straw boards frequently contain a certain amount of reactive material, and the colours of papers or cloth mounted upon them may be affected. It may be necessary to change the paper to one which is unaffected by the straw board, and if this is not feasible, a change of board may be necessary. It is not practicable to neutralise the alkali, as fresh trouble may be caused, and an unsatisfactory result be obtained. Before starting on a big job, tests should be made with the

actual materials, under factory conditions, in order that no serious loss by spoilage or stoppage may occur.

Cutting.—All knives, whether circular or straight, must be kept sharpened in order to produce clean edges. Soft cards and papers give more trouble than moderately hard stock when cutting in a guillotine. Some materials should be cut by the rotary cutter when exact measurements are essential, although it may take longer. For index cards all supplies must be trimmed exactly to the same dimensions, and the very hard index boards are liable to be cut irregularly by the guillotine.

Binding.—When sheets are ruled or printed, and are afterwards to be bound, the printed or ruled horizontal lines should coincide with the machine direction, or, as it is sometimes expressed, should run with the grain of the paper. The stitching and the binding which secure the leaves will then be fully operative, whereas if the paper is held with the back of the book parallel to the machine direction, the leaves are more liable to break away from the binding. This should be applied also in the making up of guard books.

PAPER-TESTING *

A full scheme for the analysis and testing of papers will include the following: Checking the weight of the

* It is more convenient to use the metric system of weights and measures, as small quantities and dimensions are dealt with, and the decimal method is easier to use. Metric equivalents are:—

1 millimetre (mm.)	=.039 in.	1 in.	=25.4 mm.
1 gramme	=.035 oz.	1 oz.	=28.35 grm.
1 cubic centimetre (c.c.)	=.035 fl. oz.	1 fl. oz.	=28.40 c.c.

parcel and sheet; the thickness of the sheet; examination of the constituents—fibre, sizing, loading, and colouring matter; testing the tensile strength and elasticity, the resistance to folding or crumpling, and microscopical examination of the fibres. It is not necessary to carry out all these tests on every paper, but it is well to be prepared, if required, to compare two samples, using appropriate tests.

Weight.—The weight is checked on the scales, and the average variation should not exceed 5 per cent. above or below the nominal weight. (*See* various kinds of papers under "*Substance Variations*" on p. 164.) A sheet of paper is weighed on a balance which gives a direct reading for a ream of 480, 500, or 516 sheets. The demy scale is a very useful little balance. A metal plate is supplied with the scale, a piece of paper is cut exactly to the size of the plate with a sharp knife. The piece is placed on the end of a hook and the scale, marked for reams of 480, 500, and 516 sheets, and for grammes per square metre, gives the weight of a ream of demy of the substance of the pattern, and by reference to tables the equivalent weight in any other size can be found.

Size.—The size of the paper is checked, and the papermaker guarantees to be within one-half per cent. of the measurement ordered. The paper is tested at the same time for squareness.

Thickness of Sheet.—For testing the thickness of the sheet a micrometer is used. The screw micrometer is not so exact on a yielding material like paper as is the spring micrometer, which gives the reading on a dial in thousandths of an inch. Machines are obtainable in pocket or stand form, giving measurements as

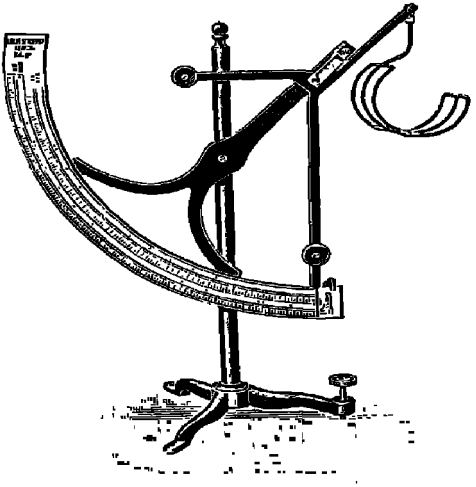

FIG. 21.—SHEET PAPER SCALE.

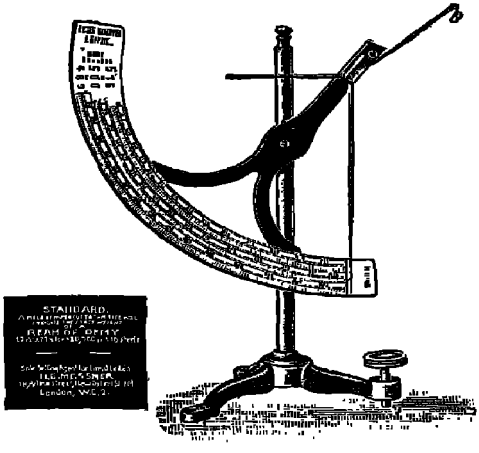

FIG. 22.—DEMY PAPER SCALE.

[*To face p.* 130.

FIG. 23.—ARBITER SHEET SCALE (*Vandome, Hunt & Co. Ltd.*).

[*To face p.* 131.

close as $\frac{1}{2000}$ in. The micrometer serves to check the thickness of supplies of paper or cards, and to indicate the bulk of a volume consisting of a certain number of pages or leaves, enabling covers for books to be prepared before the printing is completed. It is advisable to measure ten thicknesses at a time in order to avoid errors due to defects in the instrument.

Tensile Strength and Elasticity.—These tests may be carried out on various machines. The method adopted is to cut strips of a standard width from both directions of the sheet, clamp in the machine clips which are a definite distance apart, and to place the strip to be tested under tension by turning the handle of the machine, until breakage of the paper takes place. The machine registers the strain put upon the strip, and also the elongation which the strip sustained before fracture. The Schopper testing machine registers breaking strain and stretch on two scales. The strip, $\frac{5}{8}$ in. wide, is clamped between two clips 7 in. apart, and, by turning a handle, the strip under tension raises a weight at the end of a lever. The strain exerted by the weight is indicated on a scale marked in $\frac{1}{4}$-lb. divisions. The stretch is registered at the same time by a pointer actuated by a separate rack. The stretch scale and pointer are kept in unison with the strength lever, and the elongation at the time of fracture is registered. This machine, although expensive, is acknowledged to be the best for high-class papers where the narrow strip can be used.

Bursting Strain.—For quick comparative tests the Mullen, Ashcroft, and Schopper-Dalen machines are available. Testing on the Mullen machine is by hydraulic pressure, which is communicated through

the medium of glycerine to a rubber diaphragm. The paper is clamped over the diaphragm; the handle of the machine is turned, pressure being exerted until the paper bursts; the reading is given on the gauge in pounds per square inch. The Mullen machines can be supplied with various gauges, from about 30 lb. maximum, up to those with 1,000 lb. maximum. The Ashcroft is a very compact machine, a very small plunger piercing the paper, the pointer indicating the bursting strain in pounds per square inch. Two machines of this pattern are made, one for thin paper and the other for papers of ordinary and thick substances. The Schopper-Dalen machine operates with compressed air, and the readings are in similar terms to the other machines, viz., pounds per square inch.

These machines are exceedingly useful for rapid comparisons of papers, the tests being made at the same time. Slight variations in results can be obtained by turning the handles of the machines at varying speeds, but if a uniform rate is maintained, scarcely any other precaution is necessary in their use.

Opacity.—While it is possible to obtain apparatus for exact determination of the degree of opacity in paper, comparison can readily be made in a simple manner. A printed page is covered by pieces of the papers to be compared brought edge to edge over the printed matter, and the comparative degree of opacity observed by the ease, or otherwise, with which the lettering can be seen through the papers. Various optical instruments render it possible to record relative opacity of papers.

Surface or Finish.—The degree of polish which is

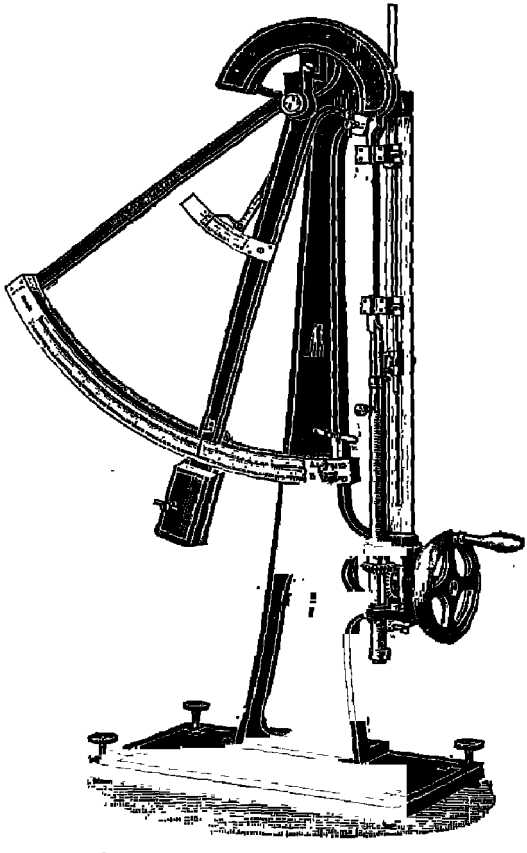

FIG. 24.—SCHOPPER PAPER TESTING MACHINE.
(*F. E. Messmer, Ltd.*)

[*To face p.* 132.

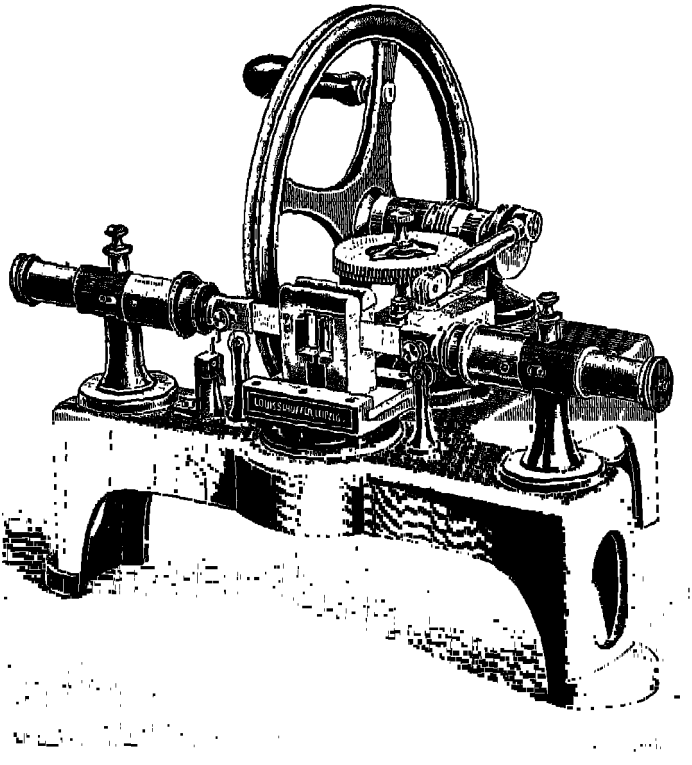

FIG. 25.—SCHOPPER FOLDING TESTER.
(*F. E. Messmer, Ltd.*)

[*To face p.* 133.

given to the paper may be compared by feeling with the hand, and also by looking along the sheet. The comparisons can be brought to a numerical basis, the Ingersoll Glarimeter being used for that purpose.

Resistance to Wear.—An ingenious machine, the Schopper Folding Tester, made for testing the resistance which paper offers to wear as exemplified by repeated folding. A narrow strip is clamped at each end, kept under constant tension by springs, and folded backwards and forwards until breakage occurs. The comparative resistance of papers of different character is shown in the table below. Other machines are available for testing the resistance of paper and boards to bending or folding fatigue, in which different design results in a slight difference in the method of applying the test.

FOLDING MACHINE TESTS

Description of Paper.	Substances, Grammes per Square Metre.	Number of Folds before Breaking.		
		Strong Direction.	Weak Direction.	Mean of Two Directions.
Japanese vellum . .	100	15,840	6,174	11,007
Manilla . . .	288	5,783	5,448	5,616
Loan—hand-made .	130	2,581	1,416	1,998
Ledger—mould-made .	140	1,344	1,023	1,183
,, machine-made .	140	1,243	1,123	1,183
Bank—hand-made . .	43	1,036	846	941
Typewriting — machine-made, all-rag . .	32	763	413	588
Blue-laid—machine-made, air-dried . . .	104	510	394	452
Blue-laid—machine-made	100	94	86	90
Printing paper . .	60	15	9	12

The tests by the folding machine, being conducted on a very narrow strip, are only moderately reliable. A more primitive method may be employed to compare papers which has the virtue of simplicity, and yet it gives a fair index to the amount of wear which the paper will withstand. Take a piece of the paper to be tested, about 6 in. square, roll it into a ball, then spread it out flat; repeat the performance, and notice how many such treatments the paper stands before perforation takes place. Papers which are very resistant —such as all-rag papers and air-dried browns—will assume a cloth-like appearance as they become softer, and it will be a long time before perforation takes place.

Tearing.—Tearing paper as a method of comparing strength is one of the simplest as well as one of the surest methods. Paper has to withstand tearing stresses, and the paper which ruptures with most difficulty is usually the most resistant to wear. Tearing will reveal whether the paper is composed of long or short fibres, and whether it is tough or brittle. The Elmendorf tearing machine provides the means for obtaining a numerical record of the tearing resistance of paper, and is the only machine which is available for the purpose.

Sizing.—To test papers for resistance to writing inks, write rather heavily upon the surface with ordinary pen and ink. Red ink is usually more penetrative than black, so it is better to use a good black ink as a standard test. As some papers, such as account book papers, have to stand erasure, they should be tested for ink bearing after abrasion of the surface.

To test for gelatine sizing, cut up a small quantity of paper and boil for a few minutes in a beaker containing sufficient water to cover the paper. Pour

off into a test tube, cool, add a few drops of a 2 per cent. solution of tannic acid. A flocculent precipitate indicates that the paper has been sized with gelatine. Heat the liquid, and the precipitate will coagulate and cling to the sides of the test tube. A comparative test is made by taking an equal quantity of each kind of paper, boiling in similar quantities of water for the same period, and adding the same amount of tannic acid solution and comparing the results.

Rosin sizing is determined in a different manner. A comparatively large quantity of paper is extracted in a small quantity of liquid. Take a strip of paper, about 8 in. × 1 in., pleat it repeatedly until it can be placed in a test tube, and cover it with rectified spirit. Place the test tube in a beaker containing water, and heat slowly. The spirit will boil before the water reaches boiling point, and in a short time the rosin will be dissolved. As soon as the solution is cool, pour it into a test tube half full of distilled water, and the rosin will appear as a ring, whitish in colour, at the junction of the two liquids. If the test tube is shaken up the opalescent appearance of the liquid indicates the presence of rosin.

Starch.—A very weak solution of iodine in potassium iodide is dropped on the paper with a glass rod, or a strip of the paper is dipped into the solution. If a very small quantity of starch is present in the paper a blue reaction will take place, and the larger the amount, the darker the coloration. Therefore, in order to form an opinion as to the quantity of starch used, a very pale solution must be used, or the colour may be too dark to enable one to make comparisons. An aqueous extract of the paper may be treated with the

iodine solution, and if a comparative test is to be made it is necessary to work on each paper with identical quantities of water for boiling, and iodine solution for testing. A faint colour must not be taken as evidence of added starch, as in rag pulp it is very difficult to remove starch from the raw materials.

Colouring Matters.—The tests for colours should be for the purpose of discovering whether they are reasonably fast to light and when wetted. The first can be tested by exposing the paper to a steady light —not sunlight—for a period according to the time of year. A photographic printing frame with a black disc on plain glass is a convenient method of testing, and if, after forty-eight hours in summer and a proportionately longer period at other times, the difference between the exposed and protected areas is marked, the paper must not be used where a permanent colour is required. Some tints will bleach completely with the treatment, and should be avoided as stock lines. Special apparatus, such as the Cooper-Hewittic mercury vapour lamp, the K.B.B. Fugitometer and the K.B.B. Fade-outfit, are designed to test fastness to light in a comparatively short time. The outfit illustrated is described as an apparatus for accelerated fading and ageing tests for materials. A special carbon arc lamp is employed, and it is claimed that the light approximates more closely to sunlight than does that from the mercury vapour lamp. To test water-fastness a piece of paper is left in warm water, or placed in cold water and heated slowly. If the colour is soluble it will very soon tint the water.

Coloured papers for pasting to book covers or boxes should be tested by pasting down to the boards

intended for use. Some boards have a curious effect on certain tinted papers owing to the presence of chemicals in the finished boards, and acidity or alkalinity may render change of covering paper necessary.

Absorbent Papers.—Blotting paper may be tested by the mounting test. To carry this out, cut strips from each direction of the paper—length and width—6 in. × 1 in. Make a pencil mark ½ in. from the end, and immerse the strip as far as the pencil mark in water or ink. The fluid immediately commences to mount the strip, and the speed at which this takes place is an indication of the relative initial absorbency of papers tested by this method. In practice, blotting paper must absorb immediately, as the pressure usually applied will, if the paper is not sufficiently absorbent, spread the ink. For this reason the rising of the fluid should be marked and checked in the first ten to sixty seconds, and when several tests in each direction have been made, the figures tabulated and the mean rate calculated. It is convenient to measure in millimetres rather than in fractions of an inch. Ink makes the better testing fluid, as the way in which the blotting paper carries up the colouring matter can be seen at once, and a paper which is superior in this respect will usually be the better paper. The zone test is an elaboration of the ink test. A small quantity (1 c.c. or .5 c.c.) is allowed to fall a drop at a time upon the blotting paper, and when the blot is dry the area of the outer non-absorbent zone, its proportion to the inner absorbent zone, and its regularity will serve as an index to the behaviour of the paper in use. Other factors in the choice of blottings are the resistance to wear, absence of fluff, and the resistance to surface dirt.

A very rough blotting paper may not be entirely satisfactory in those respects, but, on the other hand, a very smooth paper may be produced at the expense of absorbency.

Copying papers are tested in the copying press with a document written with copyable ink, and the efficiency of the paper judged either by comparison with a standard sample or merely by the clearness of the resulting copy.

Duplicating papers may be tested by drawing a fine pen charged with writing ink across the surface and immediately rubbing the ink to see if it smears. Half-sized duplicating papers have the same method applied, but should be allowed two to five seconds after writing. These methods are superseded by the use of the duplicating machine if available.

Mineral Matter—Loading.—A weighed quantity of paper—say 1 grm.—is torn into small fragments, placed in a crucible previously weighed, and subjected to the intense heat of a bunsen burner until the paper is consumed and the residue reduced to a white ash, or in any case until all carbonaceous matter is burnt off. See that any black deposit on the crucible is burnt away. Cool the crucible, weigh it with its contents, deduct the weight of the crucible, and the weight, multiplied by 100, will give the percentage of mineral matter present in the paper.

Weight of crucible . . .	6.25	grm.
Weight of paper . . .	1.00	,,
Weight of crucible and ash .	6.365	,,
Deduct weight of crucible .	6.25	,,
Weight of ash . . .	.115 × 100 = 11.5	per cent.

The ash, if not required for subsequent examination, can be thrown away, the crucible wiped out and weighed again to check the net weight of ash. It is usual to calculate the whole of the ash as added mineral water, although all fibrous materials have ash of some weight, *e.g.*, cotton, .12 per cent.; esparto, 3½ to 5 per cent. A delicate balance with weights from 50 grm. to 1 mgrm. is advised for exact results.

Fibre Composition.—It is necessary to exclude mechanical wood from most papers, and its detection is rendered easy by the use of certain solutions. A solution is made up of 1 grm. of phloroglucine in 50 c.c. of rectified spirit with 25 c.c. of concentrated hydrochloric acid added. If a drop of this solution is placed on paper in which mechanical wood is present an intensely red coloration will follow. The amount of mechanical wood may be estimated by the depth of colour, but this is very difficult, as may be proved by comparing the results obtained on papers containing 40 and 70 per cent. of mechanical wood respectively. Some aniline colours are altered in colour by the acid of the solution, although the colour is not the same as that given by mechanical wood, and it appears and fades in a different manner. A solution of 2 per cent. of aniline sulphate (1 grm. in 50 c.c. of water) will give a yellow coloration in the presence of mechanical wood. As wood fibres, jute, and some other fibres which have not been thoroughly cleaned give colour reactions as though mechanical wood were present, the microscope should be used for confirmation.

Papers containing straw or esparto fibre are coloured pink, pale or deep according to the quantity of these fibres present when heated in a weak solution of

aniline sulphate. Strips of paper treated at the same time will afford comparative tests. Bamboo paper gives a pink reaction in the heated aniline sulphate solution, but some grasses, such as delta grass, are not affected.

Microscopical Examination.—Colour reactions reveal the presence of mechanical wood, straw, and esparto in papers, but the reagents used do not reveal the presence of chemical wood or rag fibres, nor do they distinguish between cotton and linen fibres. In order to obtain more exact conclusions the microscope is employed. Although a powerful microscope is a valuable possession, a moderate instrument is preferable; any standard microscope equipped with a combination of eye-pieces and objectives to give magnifications of 59 to 270 diameters will be found excellent for the examination of fibres. A supply of slips, 3 in. × 1 in., will be required.

The fibres in most cases are securely fastened with the sizing materials, and to remove these the paper is boiled in a weak solution of caustic soda. After boiling, the paper is washed, and, with teasing needles, little pieces of paper are picked out and placed on a glass slip. Or the paper is torn up into small pieces and placed in a test tube with a little water, the thumb placed over the mouth of the tube, and by shaking violently the paper is soon reduced to pulp. A very small portion of pulp is placed on the slide, and superfluous moisture carefully removed with filter paper. A stain makes the markings on the fibres more easily seen, and if a suitable stain is employed, some differentiation in colouring the various fibres takes place.

A good standard solution (referred to as *I* in the following pages) is iodine in potassium iodide, with an accessory acid solution :—

Iodine Solution.		Accessory Solution.	
Iodine . .	1.15 grm.	Glycerine . .	10 c.c.
Potassium iodide.	2.0 ,,	Water . . .	5 ,,
Water . .	20 c.c.	Sulphuric acid .	15 ,,

A drop of the iodine solution is placed on the fibre on the slide. After a minute or so it is blotted off, and a drop of the accessory solution is added. The fibres are separated with teasing needles (needles mounted in wooden handles) until well distributed on the slide. A second glass slip is cleaned by rubbing with a piece of wash leather and used as a cover glass, and excess of solution exuding from the sides is carefully absorbed with the filter paper, and the slide is ready for examination.

Another standard solution (referred to as *Z* in the following pages) is the Herzberg zinc chloride-iodine stain, prepared as under :—

A.		B.	
Zinc chloride . .	10 grm.	Potassium iodide .	1.01 grm.
Water . . .	5 c.c.	Iodine . . .	0.5 ,,
		Water . . .	2.5 c.c.

Solution B is added to A, left overnight, and decanted into a small glass-stoppered bottle. If kept in the dark when not in use this solution should keep for a year or more without deterioration. A drop or two of this single solution is placed on the pulp; procedure in teasing-out and distributing the fibres and covering is carried out as already described.

A description of each of the principal fibres is given, with the normal dimensions of the unbeaten fibres and the coloration given by the above solutions *I* and *Z*. For general examination the lower powers of the microscope will be found most useful, the higher magnifications being employed for studying the markings and other characteristics of the fibres. The dimensions given of cotton, linen, and hemp fibres will not be met with in papers made from those materials, as in beating the lengths are shortened and frequently the fibres are split longitudinally. Tissues, copyings, and Bible papers show the greatest reduction of the fibres.

Cotton.—Fibre 30 to 40 mm. × .02 mm. Stained (*I*) violet-red to brown; (*Z*) wine-red. The fibres are long flattened tubes with large channel and numerous twists, blunt ends, and some fibres have cross markings. For a blotting the fibres are cut into short lengths, and the characteristics can be easily observed. The fibres are reduced in diameter as well as in length by prolonged beating for strong papers, the ends are frayed, and it is not easy to identify the cotton in a finely beaten rag mixture (Figs. 27 and 28).

Linen.—Fibre 30 to 40 mm. × .025 mm. Stained (*I*) violet-red to brown; (*Z*) wine-red. Linen is the fibre from the stem of the flax. The fibres have thicker walls than cotton, from which it is easily distinguished in its unbeaten state, being a smoother, rounder fibre, with marks like joints at intervals, small cross markings, and pointed ends. When beaten finely it is not possible to distinguish linen from cotton (Figs. 27 and 28).

Hemp.—Fibre 20 mm. × .025 mm. Stained, un-

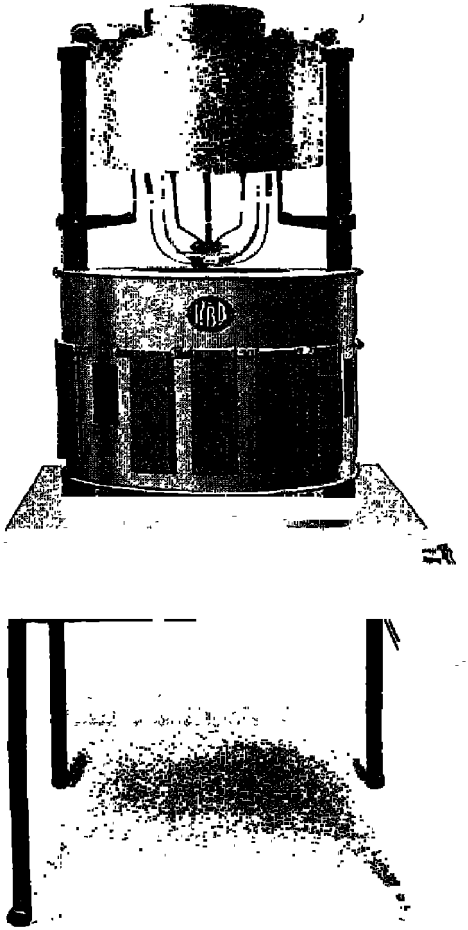

FIG. 26.—THE K.B.B. FADE-OUTFIT.
An apparatus for rapid fading and ageing tests of materials.
(*Kelvin, Bottomley, & Baird, Ltd.*)

[*To face p.* 142.

PAPERMAKING FIBRES (magnified 50 diameters).

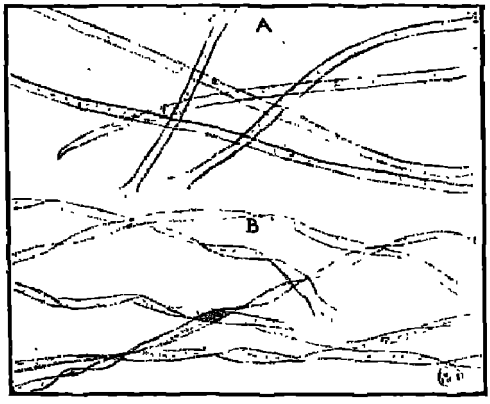

FIG. 27.—RAG FIBRES UNBEATEN.
A, LINEN. B, COTTON.

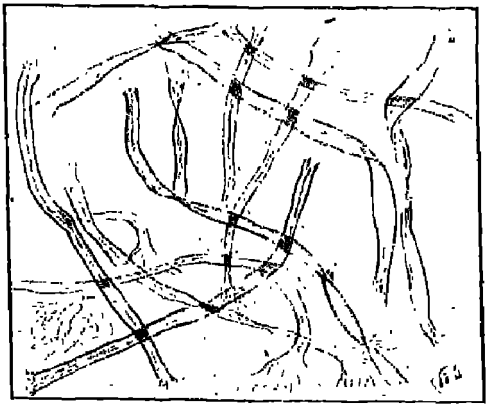

FIG. 28.—RAG FIBRES BEATEN.

PAPERMAKING FIBRES (magnified 50 diameters).

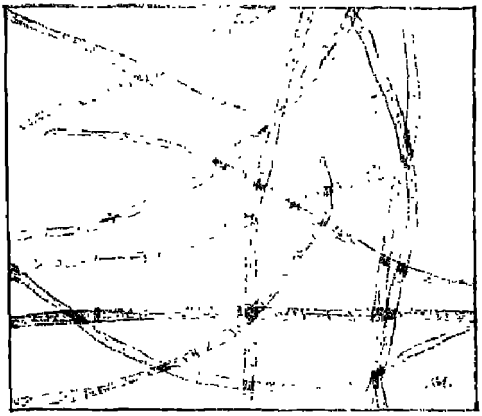

FIG. 29.—HEMP.

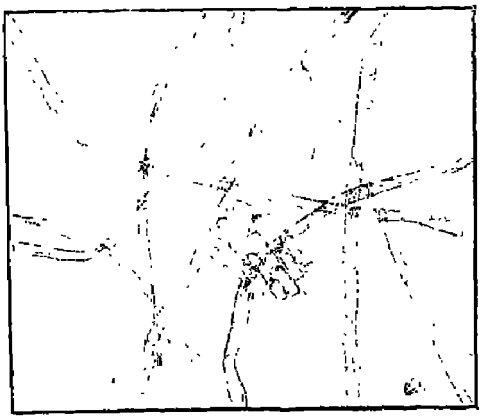

FIG. 30.—MANILLA.

PAPERMAKING FIBRES (magnified 50 diameters).

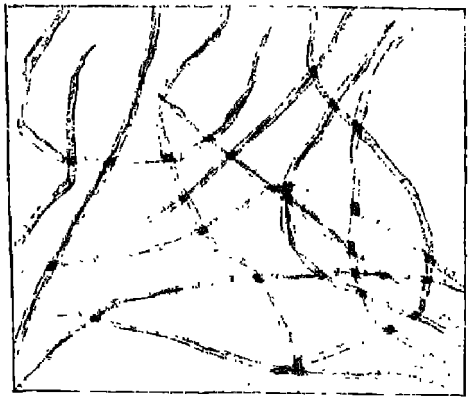

FIG. 31.—JUTE.

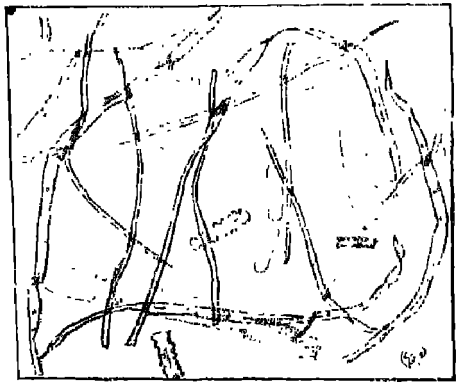

FIG. 32.—STRAW.

[*To face p.* 143.

bleached fibre (*I*), (*Z*), yellow to brown; bleached (*I*), brown-red to wine-red; (*Z*) wine-red. In general appearance the fibre is similar to linen, with slightly thinner walls, more markings, and at the places where joint markings occur are also little hairs. The ends of the fibres are rounded or flattened. The fibre in paper is usually beaten so finely as not to be recognised (Fig. 29).

Manilla Hemp.—Fibre 7 mm. × .02 mm. Stained (*I*), (*Z*), yellow to blue, according to amount of bleaching and cleaning of the raw material. The fibres are like hemp fibres, but the canal is much larger and accompanying the fibres are many oblong transparent cells, sometimes occurring like blocks of bricks (Fig. 30).

Jute.—Fibre 2.5 mm. × .022 mm. Stained (*I*), (*Z*), unbleached, yellow; bleached, brown. Jute fibres resemble linen and hemp, but the central canal is irregular in width, widening in places and narrowing again. The ends of the fibres are pointed and somewhat flattened (Fig. 31).

Straw.—Fibre 1.5 mm. × .015 mm. Stained (*I*) greyish to blue; (*Z*) blue. Similar to esparto, but the fibres are more flexible, and become kinked when made into paper. Serrated cells and transparent oval cells are present (Fig. 32).

Esparto.—Fibre 1.5 mm. × .012 mm. Stained (*I*) greyish-blue to colourless; (*Z*) blue. The fibres are very fine and short with pointed ends. Characteristics of esparto are the comma-shaped hairs and the serrated cells (Fig. 33).

Bamboo.—Fibre 4 mm. × .015 mm. Stained yellow to pale brownish-green (*I*), (*Z*). Resembling esparto,

with cylindrical fibres with pointed ends, and usually a large number of transparent oval cells are found in paper made from bamboo (Fig. 34).

Chemical Wood.—The fibres vary considerably in length and thickness. Stained blue to colourless (*I*), (*Z*). Consisting of flat ribbon-like fibres, broad flat cells pitted and perforated, others similar to sections of a plant stalk, they are on the whole unlike any other fibres. A few fibres resemble linen fibres, but comparison will reveal differences. The differentiation between pine, spruce, poplar, birch, is unnecessary for ordinary paper testing (Fig. 35).

Mechanical Wood.—Stained (*I*), (*Z*) yellow. This pulp is unmistakable owing to the broken pieces of various sizes and shapes, fragments of fibres torn away from the original wood, held together by cells, and showing pits and pores. Most newspapers are made of a mixture of chemical and mechanical wood, and microscopic examination of these mixtures furnishes an easy way of becoming familiar with the appearance of the different wood pulps (Fig. 36).

To arrive at a correct result, as regards the proportion of fibres in a mixture, is not at all easy. By taking a series of fields on one slide, counting and tabulating the contents under the headings of the different fibres, and averaging the fields, a fair approximation can be obtained. For comparison of two or more papers this will usually suffice, but considerable experience is required before one is able to formulate the furnish of a paper consisting of two or more kinds of fibre, as the different fibres have varying dimensions and weights.

Printing Qualities.—The test for comparison with

PAPERMAKING FIBRES (magnified 50 diameters).

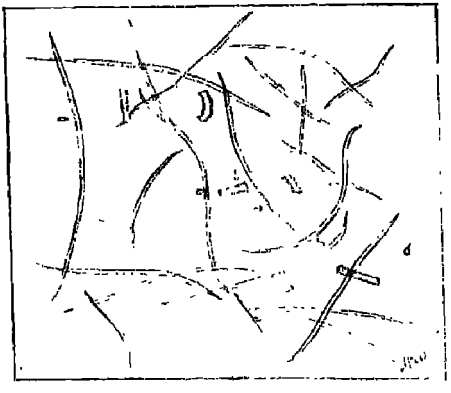

FIG. 33.—ESPARTO.

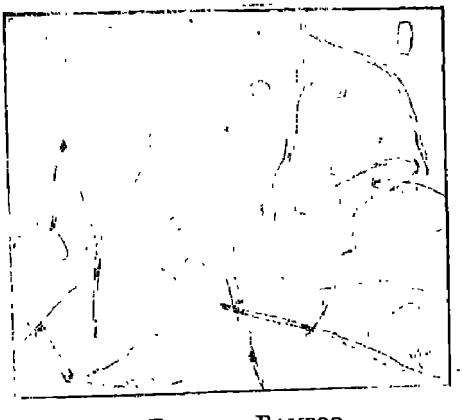

FIG. 34.—BAMBOO.

[*To face p.* 144.

PAPERMAKING FIBRES (magnified 50 diameters).

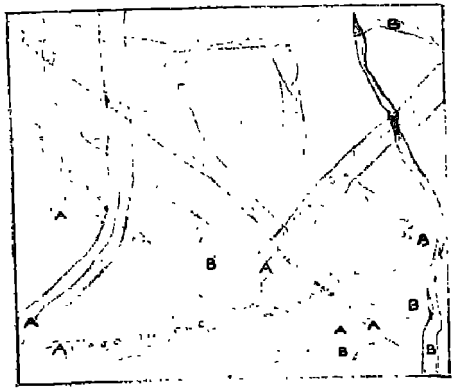

FIG. 35.—CHEMICAL WOOD.
A, PINE. B, POPLAR.

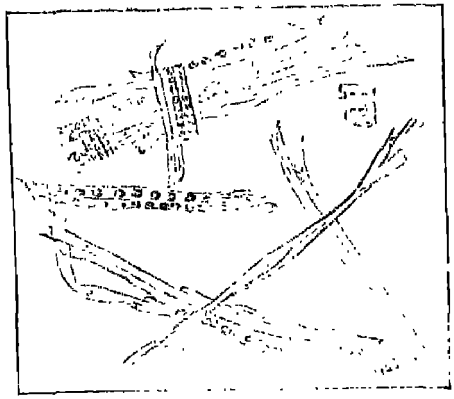

FIG. 36.—MECHANICAL WOOD.

[*To face p.* 145.

a standard paper is carried out by printing on the papers under examination at the same time, under the same conditions, and judging the brilliance, solidity of colour, absorption of ink, and noting how the colours dry. The test for the efficiency of sizing will have shown whether the paper is likely to be too porous or too hard, but the actual test for printing is advisable when taking a large quantity of a special making into stock.

The trouble of registering colour work has been dealt with at length elsewhere. If a paper has newly arrived from the mill, it is scarcely reasonable to condemn it on a trial for register before a little time has elapsed for seasoning. It is well to examine the bulk to discover if all the supply is cut with the same machine direction.

Various Faults.—Paper which has not been properly retreed—that is, the extraction of faulty sheets has not been done closely—will be found unsuitable for the highest class of work. The faults in the sheets may comprise spots, specks, creases, superficial markings, and torn paper. The spots and specks may be caused by various foreign substances—sand, dirt, knots of fibre, pieces of rubber, sealing-wax, little lumps of mineral matter or froth. The foreign matter varies with different papers, and will be more apparent in super-calendered papers than in those which are not highly rolled, as the rolling brings faults into greater prominence. Creases formed before or during calendering render sheets unfit for use. Superficial markings may occur at the drying cylinders or from marks on the other rolls, resulting in rust marks, streaks, and sometimes in bleached patches in coloured papers. Torn

paper shows hurried sorting, as it is not difficult to see such a fault when turning over the sheets. In various coated papers sheets with uneven coating or surface markings should not be included as " good " paper. A paper which is even in texture cannot be considered matched by a supply which is " wild " or cloudy in the look-through. Although wildness is sometimes accompanied by strength in paper, this is not always so, and it is desirable that printing papers should not be wild.

To analyse papers in order to discover chemical residues and to identify them requires some very delicate tests, and unless one has had an extensive chemical training, mistaken conclusions may result.

The various apparatus and chemicals necessary for paper-testing as detailed in this chapter (other than machines, chemical balance, and microscope) are detailed below.

1 glass measure, 50 c.c. capacity.
2 beakers, 225 c.c.
6 beakers, 60 c.c.
1 dozen test tubes, 5 in. × ⅝ in.
1 test-tube stand to take 6 tubes.
3 vitreosil crucibles without covers, 2¼ in. (C2).
1 tripod stand, 7 in. × 5 in.
1 piece gauze asbestos covered.
1 pipeclay triangle.
1 Bunsen burner } or one spirit
3 ft. rubber tubing } lamp, 125 c.c.
2 dozen glass slips, 3 in. × 1 in.
2 teasing needles.
1 oz. tannic acid.
1 oz. aniline sulphate.
1 oz. caustic soda.
10 oz. rectified spirit.
25 c.c. iodine in potass. iodide solution.
25 c.c. sulphuric acid and glycerine sol. or 25 c.c. Herzberg zinc chloride-iodine solution.
25 c.c. phloroglucine solution.

Messrs Townson & Mercer Ltd., of 34 Camomile Street, London, E.C. 3, undertake to supply the whole of the articles for £2. 2s. 6d. if the Bunsen burner is desired, and for £2. 4s. if a spirit lamp is to be used.

TABLES OF SIZES, WEIGHTS, AND PRICES

Sizes of Note and Letter Papers

Arranged Alphabetically

Fancy Names.	Size in Inches.	Cut Paper Sizes.	Size in Inches.
Albert	6 × 3⅞	Copy 4to	9⅝ × 7¾
Czarina	6 × 4⅛	,, 8vo	7¼ × 4⅝
Duchess	6 × 4¼	Demy 4to	9⅜ × 7⅝
Duke	6⅜ × 4⅜	,, 8vo	7⅛ × 4⅜
Emperor	7½ × 5½	Foolscap folio	13 × 8
Empire	6¼ × 4¼	,, 4to	8 × 6½
Princeps	5⅝ × 4¼	Large post 4to	10 × 8
Princess	5⅝ × 4⅛	,, 8vo	8 × 5
Prince of Wales	4½ × 3	Medium 4to	10¾ × 8⅜
Queen	5⅛ × 3½	,, 8vo	8⅜ × 5⅜
Regina	6⅝ × 4¾	Post 4to	9 × 7⅜
Viscount	6½ × 5	,, 8vo	7 × 4½

Arranged in Order of Size

Prince of Wales	4½ × 3	Demy 8vo	7¼ × 4¾
Queen	5⅜ × 3½	Viscount	6½ × 5
Albert	6 × 3⅞	Emperor	7½ × 5½
Princess	5⅝ × 4⅛	Large post 8vo	8 × 5
Princeps	5⅝ × 4¼	Medium 8vo	8⅜ × 5⅜
Duchess	6 × 4¼	Foolscap 4to	8 × 6½
Empire	6¼ × 4¼	Post 4to	9 × 7⅜
Czarina	6 × 4⅛	Demy 4to	9⅜ × 7⅝
Post 8vo	7 × 4⅜	Copy 4to	9⅝ × 7¾
Regina	6⅝ × 4¾	Large post 4to	10 × 8
Duke	6⅜ × 4⅜	Medium 4to	10¾ × 8⅜
Copy 8vo	7¼ × 4⅝	Foolscap folio	13 × 8

Sizes of Writing Papers, Etc.,* with the Extremes of the Usual Stock Weights

Name of Paper.	Size in Inches.	Area in Square Inches.	Extremes of Stock Weights.
			Lb. per 1,000.
Pott	15 × 12½	187½	14 to 25
Foolscap	16½ × 13½	218⅝	14 ,, 47
Small post	18½ × 14½	268¼	20 ,, 60
Post	19 × 15¼	289¾	22 ,, 65
Sheet-and-a-third foolscap	22 × 13½	291½	45
Small demy	20 × 15½	310	40 to 54
Sheet-and-a-half foolscap	24¾ × 13¼	327 11/16	50
Copy	20 × 16½	330	30 to 42
Large post	21 × 16½	346½	22 ,, 60
Double pott	25 × 15	375	28 ,, 82
Small medium	22 × 17½	385	26 ,, 72
Double foolscap	26½ × 16½	437¼	28 ,, 82
Small royal	24 × 19	456	56 ,, 96
Super royal	27 × 19	513	104 ,, 117
Double post	30½ × 19	579½	40 ,, 130
Double small demy	31 × 20	620	80 ,, 108
Elephant	28 × 23	644	80 ,, 130
Imperial	30 × 22	660	140 ,, 156
Double large post	33 × 21	693	40 ,, 130
Atlas	34 × 26	884	170 ,, 216
Double small royal	38 × 24	912	108 ,, 190
Double elephant	40 × 27	1,080	260 ,, 300
Double imperial	44 × 30	1,320	300

Sizes in italics are those adopted under Standardisation, *see* p. 171.

* Including coloured paper and papers detailed in next page.

Extremes of Prices, of Writings, Etc.

Description of Paper.	Substances. Grammes per Square Metre.	Price per Lb.
Hand-made—		
Bank	46	2s. 3d. to 3s. 6d.
Ledger	120 to 168	2s. ,, 2s. 6d.
Loan	45 ,, 100	2s. 1d. ,, 3s.
Writing	75 ,, 100	1s. 9d. ,, 3s.
Machine-made—		
Banks—tub-sized	18 ,, 52	6d. ,, 3s.
,, engine-sized	18 ,, 52	3½d. ,, 10d.
Blottings	100 ,, 520	4½d. ,, 1s. 2d.
,, interleaving	37 ,, 70	4d. ,, 6d.
Bonds—tub-sized	45 ,, 93	6d. ,, 2s.
,, engine-sized	45 ,, 93	4½d. ,, 11d.
Copying	11 ,, 67	7d. ,, 1s. 5d.
Duplicating	52 ,, 67	3½d. ,, 6d.
Ledger—tub-sized	120 ,, 168	5¾d. ,, 1s. 8d.
,, engine-sized	120 ,, 168	4½d. ,, 6d.
Typewriting	18 ,, 52	4d. ,, 2s. 3d.
Writings—tub-sized	45 ,, 156	6d. ,, 3s.
,, engine-sized	45 ,, 156	3d. ,, 10d.
Drawings		
Hand-made	93 to 289	2s. to 3s. 6d.
Machine-made—tub-sized	93 ,, 150	6¾d. ,, 1s. 8½d.
,, engine-sized	93 ,, 150	4d. ,, 7d.
Cartridges		
Tub-sized	90 to 225	6¾d. to 1s. 6d.
Engine-sized	90 ,, 225	4d. ,, 7d.

SIZES OF PRINTING PAPERS, ETC.,* WITH THE EXTREMES OF THE USUAL STOCK WEIGHTS

Name of Paper.	Size in Inches.	Area in Square Inches.	Extremes of Stock Weights.
			Lb. per 1,000.
Pott	15 × 12½	187½	10 to 27
Large foolscap	17 × 13½	229½	12 ,, 38
Post	19¼ × 15½	298⅜	30 ,, 52
Music demy	20¾ × 14⅜	298⅜	48 ,, 58
Crown	20 × 15	300	12 ,, 42
Copy	20 × 16½	330	20 ,, 40
Large post	21 × 16½	346½	20 ,, 80
Double pott	25 × 15	375	20 ,, 50
Demy	22½ × 17½	393¾	20 ,, 120
Medium	23 × 18	414	36 ,, 60
Double foolscap	27 × 17	459	20 ,, 70
Royal	25 × 20	500	32 ,, 140
Large royal	27 × 20	540	40 ,, 80
Double crown	30 × 20	600	22 ,, 160
Double post	31½ × 19¼	606⅜	66 ,, 100
Elephant	28 × 23	644	48 ,, 120
Imperial	30 × 22	660	60 ,, 120
Double large post	33 × 21	693	40 ,, 120
Quad pott	30 × 25	750	40 ,, 100
Double demy	35 × 22½	787½	44 ,, 240
Double medium	36 × 23	828	60 ,, 120
Quad foolscap	34 × 27	918	40 ,, 140
Double royal	40 × 25	1,000	60 ,, 140
Double globe	38 × 28	1,064	120 ,, 200
Double elephant †	40 × 27	1,080	80 ,, 200
Quad crown	40 × 30	1,200	40 ,, 240
Double imperial	44 × 30	1,320	120 ,, 240
Quad demy	45 × 35	1,575	80 ,, 480
Quad royal	50 × 40	2,000	120 ,, 240
Quad globe	56 × 38	2,128	240 ,, 280

Sizes in italics are those adopted under Standardisation, *see* p. 171.

* Including coloured papers, and papers detailed on next page.

† Also *Double large royal.*

EXTREMES OF WEIGHTS AND PRICES * OF PRINTINGS, ETC.

Description of Paper.	Substances. Grammes per Square Metre.	Prices per Lb.	Remarks as to Number of Sheets, etc.
Antique book paper.	65 to 150	4d. to 8½d.	Wove or laid.
Art . . .	90 ,, 185	5½d. ,, 9d.	One or two-sided.
Bible papers (*see* Oxford India paper)	...	...	...
Chart . . .	50 to 180	8d. to 1s. 6d.	...
Chromo. . .	50 ,, 185	7d. ,, 1s.	Weights given are those of uncoated papers, also sold without weight specified, as "thick" and "thin."
Collotype . .	130 ,, 225	9d. ,, 1s.	...
Cover . . .	65 ,, 220	2¾d. ,, 1s.	...
Etching. . .	...	...	...
Greaseproof (*or* imitation vegetable parchment) . .	40 to 75	3d. to 5d.	Double crown, 480
Imitation art . .	80 ,, 150	4d. ,, 5½d.	516
Litho. . . .	75 ,, 225	4½d. ,, 7½d.	480 to 516
M. G. poster . .	60 ,, 75	3¾d. ,, 5½d.	...
News printing .	40 ,, 80	2d. ,, 2½d.	500
Oxford India paper	33 ,, 40	2s. ,,2s.10d.	480, 504
,, ,, ,, (imitation)	37 ,, 45	4d. ,, 7d.	...
Plan . . .	75 ,, 90	7d. ,, 8½d.	480, 516
Plate . . .	75 ,, 370	6d. ,, 1s.	516
Printing—			
Hand-made .	75 ,, 150	2s.3d. ,, 3s.	480
Mould-made .	112 ,, 150	1s.1d. ,, 2s.	480
Machine-made .	42 ,, 150	2⅞d. ,, 5½d.	480, 516
Super-calendered.	56 ,, 150	2⅞d. ,, 5½d.	480, 516
Tissues . . .	10 ,, 30	4d. ,, 1s.	500 — Usually double crown
Vegetable parchment	40 ,, 100	4½d. ,, 7½d.	480 — Usually double crown

* The prices given in this section are for small quantities from stock. Special sizes may be liable to an extra charge for cutting. Special makings and large quantities are usually subject to a reduction of ½d. per lb.

Sizes of Cards

Showing how to Cut out of Royal Board

Name.	Size in Inches.	Number out of Royal Board, 25 in. × 20 in.	Method of Cutting Out.	
			25 in. way.	20 in. way.
Half small	$2\frac{3}{8} \times 1\frac{31}{11}$	104	13	8
Third large	$3 \times 1\frac{1}{2}$	96	8	12
Extra third	$3 \times 1\frac{3}{4}$	88	8	11
Town	3×2	72	8	9
Half large	$3 \times 2\frac{1}{4}$	64	8	8
Reduced small	$3\frac{1}{2} \times 2\frac{1}{8}$	55	11	5
Small	$3\frac{5}{8} \times 2\frac{3}{8}$	50	10	5
Carte-de-visite	$4\frac{1}{2} \times 2\frac{1}{2}$	36	9	4
Large	$4\frac{1}{2} \times 3$	32	8	4
Double small	$4\frac{3}{4} \times 3\frac{5}{8}$	25	5	5
Court and square postcard	$4\frac{1}{2} \times 3\frac{1}{2}$	25	5	5
Postcard (official size)	$5\frac{1}{2} \times 3\frac{1}{2}$	20	4	5
Large official postcard	$5\frac{7}{11} \times 4\frac{1}{11}$	4	4	4
Large court 8vo	$4\frac{7}{8} \times 4$	24	6	4
Intimation	$6 \times 3\frac{5}{8}$	20	4	5
Double large	$6 \times 4\frac{1}{2}$	16	4	4
Cabinet	$6\frac{1}{2} \times 4\frac{1}{4}$	15	5	3
Quad small	$7\frac{1}{8} \times 4\frac{3}{4}$	12	3	4
Quad large	9×6	8	4	2

Sizes in italics are those included in Standardisation scheme, *see* p. 170.

Index Cards

Showing Method of Cutting out of Index Boards, 25½ in. × 20½ in. and 30½ in. × 25½ in.

Size of Index Card in Inches.	Number out of Board, 25½ in. × 20½ in.	Method of Cutting Out.		Number out of Board, 30½ in. × 25½ in.	Method of Cutting Out.	
		25½ in. way.	20½ in. way.		30½ in. way.	25½ in. way.
5 × 3	32	8	4	50	10	5
6 × 4	20	4	5	30	5	6
8 × 5	12	3	4	18	6	3

Extreme Prices of Boards

Royal, 20 in. × 25 in., except where other sizes are stated

Description of Boards.	Substances.	Prices per 100.
Antique and programme	...	6s. 6d. to 20s.
Art, coated both sides	4 to 5 sheet	14s. ,, 22s.
Art, coated one side	5 ,, 10 ,,	12s. ,, 38s.
Bristol (royal, 22½ in. × 18 in.)	2 ,, 6 ,,	80s. ,, 250s.
Chromo, coated one side	3 ,, 12 ,,	15s. ,, 48s.
Cloth-lined and cloth-centred	...	22s. ,, 45s.
Ivory	Various thicknesses	7s. 0d. ,, 50s.
Paste boards	3 to 16 sheet	6s. 6d. ,, 37s. 6d.
Postcard, white, 28½ in. × 22½ in.	...	11s. ,, 15s.
Postcard, art, 28½ in. × 22½ in.	...	14s. 6d. ,, 20s.
Pulp	2 to 7 sheet	4s. 6d. ,, 22s.
Tinted and duplex	4 sheet	6s. 6d. ,, 15s.
Ticket, white one side	6 to 14 sheet	12s. ,, 24s.
Ticket, white both sides	,, ,,	15s. ,, 30s.
Ticket, tinted one side	,, ,,	15s. ,, 30s.
Triplex	3 ,, 10 ,,	5s. ,, 18s.
Window ticket	12 ,, 16 ,,	40s. ,, 60s.
Index boards, 20½ in. × 25½ in.	14 to 36 lb. per gross	7s. to 30s.
Index boards, 25½ in. × 30½ in.	22 ,, 54 ,, ,,	10s. ,, 45s.

Extremes of Weights and Prices of Browns and Wrappings

Name of Paper.	Substances. Grammes per Square Metre.	Prices per Cwt.	Usual Sizes.
Browns . .	67 to 180	12s. to 32s. 6d.	Various
Drapers' caps .	20 ,, 40	11s. 6d. ,, 26s.	Double crown
Krafts . .	40 ,, 200	26s. ,, 28s.	...
M. G. caps .	25 ,, 70	28s. ,, 34s.	Double crown and quad crown
Sealings, M.G., unglazed, and coloured	45 ,, 90	28s. ,, 45s.	Various
Rope browns .	67 ,, 200	30s. ,, 35s.	Various

MILL BOARDS

Thicknesses and Sizes

Description.	Thickness.	.036" 6D	.048" 7D	.064" 8D	.092' 8DX	.116" 8DXX	.144" 10D
	No. of Dozens in Bundles.	6	6	6	5	4	3
	Size.	Approximate Weight of Bundles in Lbs.					
Pott . . . P	17¼ × 14¼	28	38	48	54	58	56
Foolscap . . FC	18½ × 14½	31	42	52	59	64	61
Crown . . C	20 × 16¼	37	52	63	72	77	75
Small half royal . SHR	20½ × 13	30	41	52	58	62	60
Large ,, ,, LHR	21 × 14	33	45	58	64	70	67
Short . . . S	21 × 17	40	55	69	78	84	82
	No. of Dozens in Bundles.	6	6	5	4	3	2
Small half imperial . . SHI	22¼ × 15	38	52	54	63	60	51
Half imperial . HI	23½ × 16½	44	60	63	70	69	59
Middle or small demy . . M	22½ × 18½	48	64	68	74	74	62
Large middle or large demy . LM	23¾ × 18½	50	68	72	78	78	67
Large or medium . L	24 × 19	52	70	74	80	81	70
Small whole royal SR	25½ × 19½	57	80	81	88	88	76
	No. of Dozens in Bundles.	6	6	4	3	2	2
Large whole royal LR	26¾ × 20¾	63	87	75	73	66	84
Extra royal . . ER	28¼ × 21½	69	95	80	81	72	93
	No. of Dozens in Bundles.	6	4	3	2	2	2
Whole imperial . I	32 × 22½	82	74	72	63	85	110

Only those sizes in general use are given.

VARIOUS CALCULATIONS

For the rapid calculation of equivalent weights of papers of varying sizes there are several excellent calculators in the form of slide rules or similar devices. Conversion of weights per 1,000 sheets to 480's, 500's, 516's can be readily made, and other problems provided for include output of papermaking machines, prices per ton, effect of various discounts. Each of the calculators is provided with a descriptive booklet, by means of which the scope of the apparatus can be understood. Thomlinson's Equivalent Paper Scale, the Rothmill Paper Trade Rule, and Gristwood's Paper Equivalator are three different forms, and the student should examine all three and decide which will provide him with solutions for most of his problems.

These aids to rapid calculation should be utilised to the full, but it is advisable to observe and to detect illogical results which may sometimes occur, due entirely to faults in manipulation, and not to any defects in the calculators themselves.

To Calculate the Weight of a Paper from the Size and Weight of another Paper.—A table of equivalent weights of papers of regular sizes based on demy of certain weights is given on pp. 160-61. To find the weight of other sizes, multiply the weight in pounds by the area of the new size in inches, and divide by the area of the size, the weight of which is known.

Example.—The weight of large post is required equivalent to double large foolscap 30 lb.

$$\frac{30 \times 21 \times 16\frac{1}{2}}{17 \times 27} = 22\tfrac{11}{17} = 23 \text{ lb. large post.}$$

If the table of equivalent weights be examined it will be seen that the area of large post is 346½ sq. in., and that of double large foolscap 459 sq. in. For approximate purposes these may be taken as 350 and 460, and this shows large post to be practically three-quarters of the area of double foolscap. Other instances may be cited: demy 393¾ sq. in., if taken as 400, renders royal as one-fourth extra, and double crown one-half above the demy weights. These figures are useful for quick calculation, but the first method is more exact and should be generally adopted.

Conversion of grammes per square metre to weight in pounds in given size and given number of sheets, and vice versa:—

w = weight in lb.
a = area in inches.
s = number of sheets.
gsm = grammes per square metre.
f = factor = 703125.

$$a \times s \times gsm \div f = w.$$
$$w \times f \div a \times s = gsm.$$

E.g., What is the weight of quad demy 45 × 35, 500 sheets, substance of 100 grm. per square metre?

$$45 \times 35 \times 500 \times 100 \div 703125 = 112 \text{ lb.}$$

What is the substance in grammes per square metre of quad crown 40 in. × 30 in., 120 lb. per 1,000 sheets?

$$120 \times 703125 \div 40 \times 30 \times 1{,}000 = 70.3125 = 70 \text{ grm.}$$

To find the Number of Copies of a Book that may be obtained from a given quantity of Paper.—A publisher sends in 13,500 sheets of quad crown for a crown octavo work of 216 pages. What quantity of paper should be allotted for each sheet, and how many

copies will be produced? A sheet of crown octavo = 16 pages, therefore quad crown = 64 pages.

$\frac{216}{64} = 3\frac{3}{8}$ sheets quad crown. $13500 \div 3\frac{3}{8} = 4000$.

Therefore 4,000 sheets will be allotted for each of the three sheets of quad crown, and 1,500 sheets for the oddments. The spoilage on a run of 4,000 sheets will be from 1 to 2 per cent. The number of copies should be 3,950.

To find the Quantity of Paper required for an Edition of a Book of a given Size.—An edition of a book of 400 pages demy octavo, 6,500 copies is required. What quantity of double demy should be issued? A sheet of double demy will contain 32 pages.

Therefore,

$$\frac{6500 \times 400}{32} = 81250 \text{ sheets},$$

plus an allowance of 2 per cent. for spoilage = 1,625 sheets additional; total issue = 82,875 sheets.

To find the Number of Sheets which a Reel of Paper will Produce.—Weigh the reel and deduct the weight of the core or centre. Cut a piece the full size of the sheet, but if a trim is allowed, the sheet cut should be untrimmed size. Weigh the sheet on the sheet scale, read the weight in 500's, and divide the weight given into the net weight of the reel, and multiply the result by 500, this giving the number of sheets which will be produced.

Example.—Reel is 50 in. wide, weighs 740 lb.; the centre is 10 lb. in weight; to be cut to sheet 25 in. × 20 in. Sheet 25 in. × 20 in. = 25 lb. per 500.

$$740 - 10 = 730 \text{ lb.} \div 25 = \frac{730}{25} \times 500 = 14600 \text{ sheets}.$$

Alternatively a square may be cut by the demy

template, weighed on the demy scale, the weight of the sheet equivalent to the demy weight calculated or obtained from table, and the number of sheets obtained as in above example.

Example.—Reel is 48 in. wide, weighs 640 lb. with 4 lb. centre; to be cut to 24 in. × 36 in.; demy = 42 lb. per 1,000 sheets.

$$640 - 4 = \frac{636 \times 1000 \times 17\frac{1}{2} \times 22\frac{1}{2}}{24 \times 36 \times 42} = 6901 \text{ sheets.}$$

To Calculate the Weight of a Ream containing a Larger or Smaller Number of Sheets.—Multiply the weight by the factor given below, or else add or subtract the fraction representing the difference in the number of sheets.

TABLE OF FACTORS

	480	500	504	516	1,000
480	...	1.042	1.05	1.075	2.083
500	.96	...	1.008	1.032	2.000
504	.95	.992	...	1.022	1.984
516	.93	.969	.977	...	1.938
1,000	.48	.5	.504	.516	...

TABLE OF FRACTIONS *

	480	500	504	516
480	...	$+\frac{1}{24}$	$+\frac{1}{20}$	$+\frac{21}{40}$
500	$-\frac{1}{25}$	...	$+\frac{1}{126}$	$+\frac{4}{125}$
504	$-\frac{1}{21}$	$-\frac{1}{126}$	...	$+\frac{1}{42}$
516	$-\frac{3}{43}$	$-\frac{4}{120}$	$-\frac{1}{43}$	...
1,000	$-\frac{13}{25}$	$-\frac{1}{2}$	$-\frac{62}{125}$	$-\frac{121}{250}$

* Add or subtract the fraction of the weight of the ream, as shown.

EQUIVALENT WEIGHTS OF PAPERS OF VARIOUS SIZES BASED ON THE WEIGHT OF DEMY, $22\frac{1}{2}'' \times 17\frac{1}{2}''$ (dark figures), AND WEIGHT PER 1,000 SHEETS OF PAPERS OF VARIOUS SIZES BASED ON GRAMMES PER SQUARE METRE (italic figures).

(*The sizes shown in italics are standard sizes. See p.* 171.)

Area in Square Inches.	Size of Paper.	Size in Inches.	½ (·9)	1 (1·8)	2 (3·6)	3 (5·4)	4 (7·1)	5 (9)	6 (10·7)	7 (12·5)	8 (14·3)	9 (16·1)	10 (17·9)	12 (21·4)	14 (25)	28 (50)
$218\frac{3}{8}$	*Foolscap*	$16\frac{1}{2} \times 13\frac{1}{2}$	.28	.56	1.11	1.66	2.22	2.78	3.33	3.88	4.44	5.00	5.55	6.66	7.77	15.53
$229\frac{1}{2}$	Foolscap, large	$17 \times 13\frac{1}{2}$	.29	.58	1.17	1.75	2.33	2.91	3.50	4.08	4.66	5.25	5.83	6.99	8.15	16.31
$268\frac{3}{4}$	*Small post*	$18\frac{1}{2} \times 14\frac{1}{2}$	.34	.68	1.36	2.04	2.72	3.41	4.09	4.76	5.45	6.13	6.81	8.17	9.53	19.07
$291\frac{1}{2}$	*Sheet-and-one-third foolscap*	$22 \times 13\frac{1}{4}$	.37	.74	1.58	2.22	2.96	3.70	4.44	5.18	5.92	6.66	7.40	8.88	10.36	20.72
300	Crown	20×15	.38	.76	1.52	2.28	3.05	3.81	4.57	5.33	6.10	6.86	7.62	9.14	10.67	21.76
310	*Small demy*	$20 \times 15\frac{1}{2}$	.39	.78	1.55	2.33	3.11	3.89	4.66	5.44	6.22	6.99	7.77	9.32	10.88	---
$327\frac{1}{10}$	*Sheet-and-a-half foolscap*	$24\frac{3}{4} \times 13\frac{1}{4}$	.83	1.66	2.50	3.33	4.16	5.00	5.83	6.66	7.49	8.33	9.99	11.66	13.32	21.76
$346\frac{1}{2}$	Large post	$21 \times 16\frac{1}{2}$	.44	.88	1.76	1.64	3.52	4.40	5.28	6.16	7.04	7.92	8.80	10.56	12.32	24.64
385	*Small medium*	$22 \times 17\frac{1}{2}$	.49	.98	1.96	2.93	3.91	4.89	5.87	6.85	7.82	8.80	9.78	11.73	13.68	27.37
$393\frac{3}{4}$	Demy	$22\frac{1}{2} \times 17\frac{1}{2}$	.50	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	12.00	14.00	28.00
414	Medium	23×18	.53	1.05	2.10	3.15	4.20	5.26	6.31	7.36	8.41	9.46	10.51	12.61	14.71	29.43
$437\frac{1}{2}$	*Double foolscap*	$26\frac{1}{2} \times 16\frac{1}{2}$	.56	1.11	2.22	3.31	4.44	5.55	6.66	7.77	8.88	9.99	11.10	13.32	15.54	31.08
456	*Small royal*	24×19	.58	1.16	2.32	3.47	4.63	5.79	6.95	8.11	9.26	10.42	11.58	13.89	16.21	32.43
459	Double large foolscap	27×17	.58	1.17	2.33	3.50	4.66	5.83	6.99	8.16	9.33	10.49	11.66	13.98	16.31	32.63
500	Royal	25×20	.63	1.27	2.54	3.81	5.08	6.35	7.62	8.89	10.16	11.43	12.70	15.23	17.77	35.55
513	*Super royal*	19×27	.65	1.30	2.60	3.90	5.21	6.51	7.82	9.12	10.42	11.72	13.03	15.66	18.24	36.48
540	Large royal	27×20	.68	1.37	2.74	4.11	5.48	6.85	8.22	9.59	10.96	12.33	13.70	16.44	19.18	38.36

Equivalent Weights of Papers of Various Sizes based on the Weight of Demy, $22\frac{1}{2}'' \times 17\frac{1}{2}''$.

Area in Square Inches.	Size of Paper.	Size in Inches.	½ (·9)	1 (1·8)	2 (3·6)	3 (5·4)	4 (7·1)	5 (9)	6 (10·7)	7 (12·5)	8 (14·3)	9 (16·1)	10 (17·9)	12 (21·4)	14 (25)	28 (50)
600	Double crown .	30×20	.76	1.52	3.05	4.57	6.10	7.62	9.14	10.69	12.19	13.72	15.24	18.28	21.33	42.66
620	*Double small demy*	31×20	.79	1.57	3.15	4.72	6.30	7.87	9.44	11.02	12.59	14.17	15.74	18.89	22.04	44.08
660	Imperial . .	30×22	.84	1.68	3.35	5.03	6.70	8.38	10.06	11.73	13.41	15.08	16.76	20.11	23.46	46.92
693	Double large post	33×21	.88	1.76	3.52	5.28	7.04	8.80	10.56	12.32	14.08	15.84	17.60	21.12	24.64	49.28
787½	Double demy .	35×22½	1.00	2.00	4.00	6.00	8.00	10.00	12.00	14.00	16.00	18.00	20.00	24.00	28.00	56.00
828	,, medium	36×23	1.05	2.10	4.20	6.31	8.41	10.51	12.62	14.72	16.82	18.93	21.03	25.23	29.43	58.87
912	*Double small royal*	38×24	1.16	2.32	4.63	6.95	9.26	11.58	13.89	16.21	18.52	20.84	23.16	27.79	32.42	64.84
1,000	Double royal .	40×25	1.27	2.54	5.08	7.62	10.16	12.70	15.24	17.78	20.32	22.86	25.40	30.47	35.55	71.11
1,200	Quad crown .	40×30	1.52	3.05	6.10	9.14	12.19	15.24	18.28	21.33	24.38	27.42	30.47	36.57	42.66	85.32
1,320	Double imperial	44×30	1.68	3.35	6.70	10.06	13.41	16.76	20.11	23.46	26.82	30.17	33.52	40.22	46.93	93.85
1,575	Quad demy .	45×35	2.00	4.00	8.00	12.00	16.00	20.00	24.00	28.00	32.00	36.00	40.00	48.00	56.00	112.00
2,000	,, royal .	50×40	2.54	5.08	10.16	15.24	20.32	25.40	30.48	35.56	40.64	45.72	50.80	61.94	71.10	142.21

To obtain equivalent weights of heavier papers, take the column which is a multiple of the weight, and multiply: *e.g.*, 72 lb. demy, equivalent in imperial required; 12 lb. demy=20.11; 72=20.11×6=120.66=121 lb. Or take the unit column from table, multiply and add: *e.g.*, demy 65 lb., equivalent weight required in large royal; 6 lb. demy=8.22 large royal. ∴ 60 lb.= 82.2; 5 lb.=6.85=89.05=89 lb. large royal. The table may, of course, be used to obtain all equivalents, such as imperial, 40 lb.; required weight of demy=24 lb. demy. The nearest whole number should be taken, except when ordering regular stock weights.

The small italic figures in parentheses at the head of the table represent grammes per square metre, and the equivalents in the columns are direct readings for 1,000 sheets of the substance shown in grammes per square metre. Thus 50 grm. per square metre in double demy is 56 lb. per 1,000 sheets. Large post in substance of 90 grm. per square metre=44 lb. per 1,000 sheets. Large double foolscap, 125 grm. per square metre=77.7=78 lb. per 1,000 sheets. (It will be observed that in the later examples the figures are multiplied by 100 and 10 respectively.)

PAPER TRADE CUSTOMS, 1922

Codified and adopted by the Papermakers' Association of Great Britain and Ireland (Incorporated), The National Association of Wholesale Stationers and Paper Merchants, The Employers' Federation of Envelope Makers and Manufacturing Stationers, and The United Kingdom Paper Bag Manufacturers' Association.*

Group Reference Letters.—**A.** Cloth-lined papers, coated art papers and enamels, copyings, tissues, drawing cartridges, drawing papers, blottings, dryings, filterings, duplicator, foils, gum papers, insulating papers, machine writings and printings, pulp boards, tracing papers, envelope papers, manillas for other than wrapping purposes, caps for other than wrapping purposes, and similar papers.

B. Cards, paste boards, glazed pressing boards, greaseproof imitation parchment, news, waterproof papers, waxed, and similar papers.

C. Box boards, browns, corrugated straw, leather board middles, mill boards, mill wrappers, sugars, casing krafts, sealings, wrappings, cartridges, and similar papers.

Conditions of Sale.—Prices may be agreed :—

1. By weight, whether put up in reams, rolls, or any other form.
2. Per ream, based upon nominal weight.

Terms and Delivery.—1. Quotations are understood to be net and carriage paid to buyer's address. Goods invoiced and dispatched up to and including 25th of the month shall be paid for during the following month provided delivery has been effected by date when payment is due.

* Now The National Association of Paper Merchants.

2. Delivery in the British Isles shall include delivery at buyer's warehouse or that of his consignee.

Packing and Marking.—Boards, frames, cases, and special (not ordinary) cardboard centres shall be chargeable at reasonable rates, to be refunded in full when returned within a reasonable time, carriage paid and in good condition. The outside of the wrapper of each ream shall be marked with the nominal weight, except in cases where the weight charged is above nominal.

Machine-made Writings, Printings, etc.—A ream contains 500 sheets.

Reams are graded as "Good," "Retree," and "Broke."

"Retree" is subject to 10 per cent. reduction.

"Broke" is subject to 20 per cent. reduction.

All fine papers under 15 lb. Large post 500's shall be classed as "Bank."

Wrappings, Caps, etc.—A ream contains 480 sheets.

Hand-made Papers.—A "Mill" ream, "Good" or "Retree," contains 472 sheets, consisting of 18 "Inside" quires of 24 sheets each and two "Outside" quires of 20 sheets each.

The "Outside" quires are placed one at the top and one at the bottom of the ream.

An inside ream, "Good" or "Retree," contains 480 sheets, made up of 20 "Inside" quires of 24 sheets each.

"Retree" is subject to 10 per cent. reduction, and "Broke" to 50 per cent. reduction.

Wrappers.—The chargeable weight shall include weight of necessary ream and reel wrappers (not bale

wrappers), string, and centres (excepting those of wood or metal).

Substance Variations.—Average variation shall not exceed 5 per cent. either way.

Group " A "—Nominal weight of sheets and reels shall be chargeable if actual weight exceeds or is not more than 2½ per cent. under nominal weight. Actual weight shall be chargeable if more than 2½ per cent. under nominal weight.

Group " B "—Actual weight of sheets and reels shall be chargeable up to 2½ per cent. in excess of nominal.

Group " C "—Actual weight of sheets and reels shall be chargeable, provided average variation does not exceed 5 per cent. either way.

Short Yardage.—Claims for short yardage can only be based upon result obtained from yardage measurements.

Measurement Variations.—1. Width of reels shall not vary more than ½ per cent. with a maximum permissible variation of ¼ in.

2. The variation in measurement of paper in sheets must not exceed ½ per cent. either way above or below the ordered measurement, provided always that where ½ per cent. is greater than ¼ in. the permissible variation shall be ¼ in., and that where ½ per cent. is less than ⅛ in. the permissible variation shall be ⅛ in.

Special Makings.—For makings of Groups " A," " B," and " C " of special size, substance, tint, watermark, etc., an order shall be deemed to be properly filled if the quantity supplied is within

the following limits either way of the quantity ordered :—

One ton or less	12½ per cent.	Not applicable to hand and mould mades.
Above 1 ton and not exceeding 5 tons	7½ ,,	
Above 5 tons	5 ,,	

Any excess beyond such limits shall be cut down to the nearest standard size and taken by the buyer at the proportionate price of such size.

Breakage Charges.—Where any order of less than 500 sheets involves breakage of a mill packet there shall be an extra charge of 10 per cent. with a minimum of 6d. and a maximum of (*a*) 1s. 6d. when the price is 60s. or less per 1,000 sheets, or (*b*) 2s. 6d. when the price exceeds 60s. per 1,000 sheets.

(*a*) *Special Makings of Hand-made and Mould-made Papers.*—For makings of hand-made and mould-made papers of special size, substance, tint, watermark, etc., an order shall be deemed to be properly filled if the quantity supplied is within the following limits either way of the quantity ordered :—

Orders not exceeding 10 cwt.	10 per cent.
Orders over 10 cwt. and not exceeding 15 cwt.	7½ ,,
Orders over 15 cwt. and not exceeding 1 ton	5 ,,
Orders over 1 ton	3¾ ,,

The above percentages apply to whole makings and not to the final instalments of makings only.

The overmaking in all cases to include retree and outsides.

Materials.—Unless it is otherwise expressly stipulated in the order, the papermaker shall be free to use his discretion in the selection of materials.

Dandy Rolls and Moulds.—Buyers requiring a special watermark shall provide the roll or moulds free of charge to the papermaker.

Deliveries.—Deliveries may be suspended in the event of:—

1. Any contingency arising beyond the control of the buyer or seller, such as war, fire, drought, interruption of transport, impediment to navigation through ice, strikes, lock-outs, and the like.
2. Any accident and/or partial damage during such time as may be required to make good such accident and/or damage.

The buyer or seller, as the case may be, shall give prompt notice to the other party of the cause and commencement of such suspension, and in like manner when it ceases.

In such cases deliveries shall be resumed as soon as is practicable, and where they form part of a contract spread over periods of time, they shall be resumed at the same rate as provided for in the contract.

In the event of the works of the buyer or seller being totally destroyed, and not rebuilt or replaced within twelve months, the contract shall be considered null and void.

In the case of contracts for delivery in instalments, each delivery shall be considered a separate contract.

Delayed Deliveries.—1. Specification of makings shall be sent to the seller in reasonable time for delivery on due date. If the paper contracted for be ready for delivery on the specified date, and the buyer does not take delivery when requested by the seller to do so,

it shall be invoiced forthwith and invoice taken to account. If the whole of the delivery be not ready, the seller shall not be entitled to invoice any portion.

2. Paper stored at mill shall be subject to a rent charge of 6d. per ton per week for any period it lies at mill after fourteen days from date of invoice, except in cases where delay is due to causes beyond buyer's control. Maximum period for storing at mill shall be three months.

Complaints of Quality, etc.—Claims for defective quality, short weight, etc., shall be made in writing within fourteen days after delivery, but this is not to operate in cases where defective quality cannot reveal itself during this period. Such protection shall not be given beyond three months. In cases where delivery is within the British Isles, at least half the parcel must be available for examination.

For export business, six representative outturn sheets shall be supplied with invoice, but the English exporter is entitled to return to the question of quality in cases where his export buyer subsequently reports any defect not revealed by outturn sheets.

Contracting Out.—Any or all of these terms may be varied or made inapplicable by the terms of the contract or order.

Arbitration.—1. All disputes arising under any contract or order shall be submitted to arbitration in the United Kingdom.

2. Each party shall appoint his arbiter, and the arbiters shall choose their umpire before proceeding. If the dispute relates to quality, the arbiters and umpires must be experts in paper, and they shall decide whether the paper complained of is a fair

commercial match of quality to be supplied. Should they decide that it is not, they may authorise rejection, or they may order acceptance subject to stated allowance, in which latter case they shall state whether the allowance shall apply to all or part of such portion as has been used before their examination, and their decision shall be final and binding on both parties. Should either side fail to appoint his arbiter within the prescribed fourteen days, the arbiter appointed by the other party shall act for both, and his award shall be binding on both parties as though he had been appointed with their joint consent. The costs of such reference shall be borne as the arbiters and umpire decide.

Note.—The Trade Customs, as codified in January 1906, are hereby cancelled.

STANDARDISATION OF PAPER AND BOARDS, 1925

(*Excluding Wrapping Papers, Straw Boards, and Mill Boards*)

It is agreed between the Federation of Master Printers of Great Britain and Ireland, and the National Association of Wholesale Stationers and Paper Merchants,* that it is desirable to introduce standardised methods for selling and dealing in paper and certain classes of boards. The following standards are mutually agreed, and the members of the National Associa-

* Now the National Association of Paper Merchants.

tion of Wholesale Stationers and Paper Merchants will as soon as possible convert their stocks and price lists to conform with the new standards. The Federation of Master Printers of Great Britain and Ireland will actively support the adoption of these new standards by all their members.

These conditions apply to paper, cards, pulp, paste, and Bristol boards, but do not include wrapping papers, straw boards, and mill boards.

Sale by Weight and by Thousand.—All papers and boards to be sold by the 1,000 sheets. Sheets of paper and boards to be packed in 1,000's, 500's, 250's, or 100's, according to size and weight, as may be most convenient. If a master printer requires less than the quantity usually packed, the paper or boards should be supplied in 10, 20, or 25 sheets, or some other decimal part of a thousand.

Standard Sizes.—All papers, cards, pulp, paste, and Bristol boards sold under a name to be cut to standard size as specified hereafter.

All papers and boards not standard size to be considered a special or off-size, and listed or sold by inch measurement, and not by a standard name.

All papers and boards to be cut square and with clean edges, except deckle edge and hand-made papers.

Boards.—All cards, pulp, paste, and Bristol boards to be described, at the option of the seller, either by the thickness thereof stated in thousandths of an inch, or pounds weight per 100 boards. A variation of 5 per cent. in thickness or weight either way to be allowed.

Cards to be sold as 50's, 100's, etc., and not in uneven quantities.

The standard size of cut cards to be as follows:—

Name.	*Size.*	*Name.*	*Size.*
Thirds	$1\frac{1}{2} \times 3$	Court	$3\frac{1}{2} \times 4\frac{1}{2}$
Extra thirds	$1\frac{5}{8} \times 3$	Double small	$3\frac{5}{8} \times 4\frac{3}{4}$
Small	$2\frac{5}{8} \times 3\frac{5}{8}$	Cabinet (photo)	$4\frac{1}{4} \times 6\frac{1}{2}$
Carte-de-visite	$2\frac{1}{2} \times 4\frac{1}{8}$	Double large	$4\frac{1}{2} \times 6$
Large	$3 \times 4\frac{1}{2}$	Quad small	$4\frac{3}{4} \times 7\frac{1}{4}$
Postcard	$3\frac{1}{2} \times 5\frac{1}{2}$	Quad large	6×9

Marking of Package.—All packages to be clearly marked with:—

1. Quality. 2. Size in inches. 3. Weight or substance. 4. Number of sheets in the package.

Special Makings.—To the order of a customer, paper may be made in any size or number of sheets to the package, but must not be marked with the standard name unless it be in all respects a standard size and thousand. If a papermaker or stationer, to meet his customer's requirements, stocks off-size papers, they must be described by their size in inches and not by a standard name.

Variation in Weight, etc.—The percentage of variation in weight in a thousand, the over or short make in special makings, and the inclusion of the wrapper and string in the weight, as at present agreed by the British Paper Trade Customs, are not affected by these new standards.

Standard Names and Sizes for Paper and Boards.—If paper and boards are sold under a name and are untrimmed, they must be of such a size as to cut to standard size,

PAPERS (TRIMMED)

Writings.	*Size.*	*Printings.*	*Size.*
Foolscap	13½ × 16½	Large foolscap	13½ × 17
Small post	14½ × 18½	Crown	15 × 20
Sheet and ⅓ cap	13½ × 22	Large post	16½ × 21
Sheet and ½ cap	13½ × 24¾	Demy	17½ × 22½
Small demy	15½ × 20	Medium	18 × 23
Large post	16½ × 21	Royal	20 × 25
Small medium	17½ × 22	Large royal	20 × 27
Medium	18 × 23	Imperial	22 × 30
Small royal	19 × 24		
Super royal	19 × 27		
Imperial	22 × 30		

BOARDS (TRIMMED)

	Size.
Royal	20 × 25
Postal.	22½ × 28½
Imperial	22 × 30
Large imperial	22 × 32
Index	25½ × 30½

All double and quad sizes are to be exact multiples of the standard sizes.

BRITISH STANDARD SIZES FOR PAPER *

The following list of sizes has been prepared by the British Standards Institution in conjunction with Trade Associations, Scientific and Technical organisations, and Government Departments for general employment by the trades concerned, and it is hoped

* Abstracted by permission from British Standard Specification No. 730/1937, official copies of which can be obtained from the British Standards Institution, 28 Victoria Street, London, S.W.1, price 2s. 2d. post free.

that eventually the list will be adopted as a British Empire Standard List of Sizes for Paper.

On p. 171 will be found the list of sizes agreed between the Federation of Master Printers and the National Association of Paper Merchants. The differences are small and should be noted.

WRITINGS AND PRINTINGS—ALL CUT EDGES

Name.	*Size.*
Crown, Double	20 ×30
,, Quad	30 ×40
Small Demy	15½×20
,, ,, Double	20 ×31
,, ,, Quad	31 ×40
Demy	17½×22½
,, Double	22½×35
,, Quad	35 ×45
Small Foolscap	13½×16½
,, ,, Double	16½×26½
,, ,, Oblong Double	13½×33
,, ,, Quad	26½×33
,, ,, 1/8 Sheet	13½×22
,, ,, 1/16 Sheet	13½×24¾
Foolscap	13½×17
,, Double	17 ×27
,, Quad	27 ×34
,, 1/8 Sheet	13½×22½
,, 1/16 Sheet	13½×25½
Imperial	22 ×30
,, Double	30 ×44
,, 1/8 Sheet	22 ×45

Name.	*Size.*
Medium	18 ×23
,, Double	23 ×36
Post	15 ×19
,, Double	19 ×30
Large Post	16½ ×21
,, ,, Double	21 ×33
Small Royal	19 ×24
Royal	20 ×25
,, Double	25 ×40
Large Royal	20½ ×27
,, ,, Double	27 ×41
Elephant, Double	27 ×40

Note.—All double and quad sizes in the above table are exact multiples of the standard sizes. The above designations also apply to cover papers, the sizes of which are, however, slightly larger.

Wrappings and Casings

Name.	*Size.*
Imperial	22½ ×29
,, Double	29 ×45
,, Double Double	45 ×58
Saddleback	36 ×45
* Casing	36 ×46
,, Extra Large	40 ×48
Bag Cap	20 ×24
Crown, Double	20 ×30
,, Quad	30 ×40
Double Medium	23 ×36

* In Eire and Northern Ireland 36×48 casing is used.

BOARDS—TRIMMED

Name.	*Size.*
Royal	20 × 25
Postal	22½ × 28½
Imperial	22½ × 30
,, Large	22½ × 32
Index	25½ × 30½

APPENDIX A

In the course of the inquiry it was found that there were some sizes which could not be omitted, not necessarily on account of the extent of their use but due to the fact that official and other publications have for a great number of years been issued in one or other of those sizes. It will be recognised, however, that they can only be obtained if a sufficiently large order justifies their being made. They are given below:—

WRITINGS AND PRINTINGS

Name.	*Size.*
Copy	16½ × 30
,, Double	20 × 33
Super Royal	19 × 27
Pott, Quad	25 × 32
,, ,, Double	32 × 50
Antiquarian	30 × 53
Atlas	26½ × 34
Columbier	24 × 34½
Foolscap, Quad 1½ Sheet	34 × 40½
Pinched Post	14½ × 18½
,, ,, Double	18½ × 29
Small Post	14½ × 18
,, ,, Double	18 × 29

WRAPPINGS AND CASINGS

Name.	*Size.*
Bag Cap	19 ×24
Imperial Casing	23 ×33
,, ,, Double . . .	33 ×46

APPENDIX B

Consideration is given under the headings of:—

1. *Listing and Invoicing.*—Suggested that weight in pounds per 1,000 sheets for paper and per 100 boards.
2. *Packing.*—That paper should be packed in 500 sheets and boards in 100's.
3. *Indication of Substance.*—The substance of papers and boards should be indicated in terms of grammes per square metre, and that the substance as well as the weight should be shown on all packages.

CITY AND GUILDS OF LONDON INSTITUTE EXAMINATIONS

TYPOGRAPHY AND LITHOGRAPHY

Extracts from Syllabus as regards Paper

TYPOGRAPHY

Intermediate Examination

Section A.—Compositors' Work

Sizes of papers, boards, and cards; subdivisions; standardisation of paper; papermaking; materials used; printings and writings; sizes and quantities of paper.

Section B.—Machine and Press Work

Sizes and subdivisions of printings, writings, cards, and boards; standardisation of paper; right and wrong side; materials and manufacture; properties and suitability of papers; quantities and sizes of paper.

Final Examination

Section A.—Compositors' Work

Classification and definitions; judging and testing weights; prices; allowance for spoilage; cost and

quantity of paper; equivalent weights; allowance for overs.

Section B.—Machine and Press Work.

Descriptions, definitions, and classifications; judging and testing; weights and prices; working difficulties; stretch and contraction, static, etc.; calculations.

Full Technological Certificate

The manufacture of paper; the papermaking machine; fibre-yielding material; warehouse tests for the various celluloses; soft, half, tub, and engine-sizing; china clay, its uses and how to determine proportion. The mechanical properties of paper and their quantitative measurement.

Judging Papers.—How to judge the quality of various classes of papers and their suitability for the purposes to which they are to be put. Bulk, handling, opacity, absorbency, and "look-through," strength, tear (straight and across), length of fibre. British and foreign makes and how to detect.

Stocking of Paper.—What classes to select for stocking. Racks for stock. The care of stock, samples, oddments, and useful offcuts. Tying up and marking reams. The effect of light, temperature, chemical fumes, damp and dust on the various classes of paper. Stock-keeping systems and books. Handling of flat and unprinted papers. Counting out, cutting, and squaring paper.

LITHOGRAPHIC PRINTING

Intermediate Examination

Principal materials used in papermaking; hand and machine made papers; enamel papers, plain and glazed cards; paper creasing, stretch and contraction, and the various methods of maturing; dimensions of papers.

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